

SCIENCE

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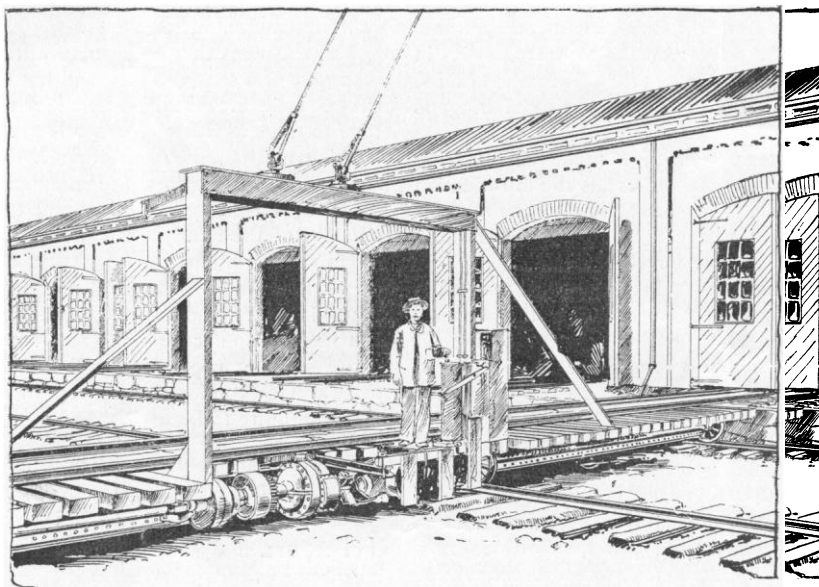
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AN ELECTRIC TRANSFER-TABLE.

THE accompanying cut represents the new transfer-table at the Fitchburg car repair shops at Fitchburg, Mass., just built by the Fitchburg Railroad Company. The table or car is moved by the Union Electric Car Company's system. The motor, gears, clutches, etc., are all on the front axle of the car. The motor is geared to the axle, and the gears run in an enclosed bath of oil. They are brass cut gears, and work with the least possible amount of friction and consequent loss of power. The switch which governs the motor and controls the car is just above the motor, on a platform built out from the front of the car, as are also the reversing

being at the dynamo, now run the table and draw on and off the cars, which work formerly required twelve men and a shifting locomotive and its men, and some four times the amount of work can be done by these three men.

The Union Electric Car Company will use this same system on the Beverly and Danvers Railroad, which is being equipped by the company, and will be running this month. These cars will use storage batteries in place of the overhead wires for the propelling power. The storage batteries are placed under the seats, with two sets to each car. They are charged by a steam and electrical plant in the car-house. Each set runs the car forty miles. It takes eight hours to charge. The batteries are changed by the con-



ELECTRIC TRANSFER-TABLE AT FITCHBURG, MASS.

bar and the handle throwing in and out the clutch by which the motor is used either to propel the car in the desired direction or to draw off and on the cars to be changed from one track to another.

The two shops are each five hundred feet long, and face each other. Each shop is divided into three divisions, separated by brick walls running through the roof. In each division there are eight tracks, making twenty-four in each shop. Between these shops, which are seventy-five feet apart, is the pit in which the table or car moves. The car is ten feet long and seventy feet wide, and runs on four rails laid in the pit. The track on the car, running from side to side, matches the tracks in the shops. The control of the table is so perfect, by the use of the switch, that it can be put and matched to any track desired without the least trouble or hitch; the same power that moved the car forward, stops or slows it. The table is run by the dynamo which lights the shops at night, and is connected by two overhead wires, on which run two trolleys, the trolley-poles being on the top of the house built over the front platform at the front of the table. Three men, one

ductor and driver in from three to ten minutes, and each car makes a run of eighty miles per day.

THE SOFTENING OF HARD WATERS FOR DOMESTIC USE.

SINCE waters possessing an inconvenient degree of hardness are very common in many localities, owing to the almost universal prevalence of calcareous soils and geological deposits, it is of no little interest to have some simple means of doing away with this property, so as to render such waters more convenient for domestic uses. This is the more important, as in some cases the presence of a large proportion of magnesia tends to cause serious, even though usually only temporary, gastric disturbance with persons unused to such waters, whereby quite frequently an unfounded prejudice against the general health-conditions of perfectly healthful localities is created. This subject has been heretofore discussed in many places, especially in California, but its continued importance and the frequent demand for information in the prem-

ises justify the more elaborate consideration recently given it by Professor Hilgard of the University of California.

When, as is most commonly the case, this hardness is due to the presence of large proportions of the carbonates of lime and magnesia, it can be recognized by the extent to which the water becomes turbid, or forms whitish scum or incrustations, when boiled. Boiling, then, is one of the means for softening waters that are hard and "curdle the soap" from this cause; and this fact is well known to housekeepers, but owing to the inconvenience of the application of this remedy, it is rarely resorted to except for drinking-water. For this purpose boiling has the special and additional advantage of insuring the destruction of any minute germs of disease that might contaminate the water.

To soften water for washing, a common and very good remedy is the use of carbonate of soda (sal soda) in sufficient quantity to bring down the lime and magnesia, and thus insure the proper solution of the soap to form suds. Only there is too often a mistake made in not allowing time for the soda to bring down the lime and magnesia in a powdery form, which requires from half an hour to an hour when the water is cold, but occurs very quickly when the water is hot. When, as is commonly done, the soap is put into the water while the lime is still in the gelatinous form and diffused in the water, a certain amount of "curdling" will still happen, and the washed clothes (especially flannels) will have that soggy and unpleasant touch which is caused by the accumulation of the lime and magnesia soaps in them.

That it is undesirable to use soda for softening water to be used for drinking hardly needs more than mention. The natural hard waters usually contain quite as much of saline matters as is desirable in drinking water. Soda, however, does not in any manner correct the sanitary condition of a water; on the contrary, it aids in keeping vegetable and animal matters in solution, and unless added in very large excess does not interfere with the vitality of fungous or other germs.

By far the most convenient and effective mode of purifying larger quantities of hard water for domestic use, is the introduction of a definite amount of quicklime, proportioned to the requirements of each particular water; a point that can be readily ascertained by any one having an ordinary capacity for observation.

The principle upon which this apparently paradoxical process is based is this: The lime and magnesia in most hard waters are contained in the form of carbonates, dissolved in the water by the aid of free carbonic acid. Whatever drives off or takes possession of this free acid will bring down the earthy substances in an insoluble form, and thereon depends the efficacy of boiling as well as of the addition of washing soda; cooking soda or bicarbonate will not produce the effect. Now, lime in the caustic condition, as lime-water, or milk-of-lime, freshly prepared, will most effectually take possession of any free carbonic acid, and will form with it the same insoluble compound that, when hard water is boiled, settles to the bottom or incrusts the boiler. Hence, when an amount of clear lime-water, just sufficient to absorb all the carbonic acid in a water, is added to it, both the lime added and the lime and magnesia originally contained, are brought down in the insoluble form, and the mineral contents of the water are diminished very materially, sometimes to less than one-half of the original amount. With the sediments thus brought down there also usually comes a large proportion of the vegetable or animal matters contained in the water; so that instead of perhaps becoming putrid in a tank serving for domestic supply, water so treated will remain clear and odorless for a long time if protected from recontamination by insects, falling leaves, dust, etc.

The only practical difficulty in carrying out this purification is the ascertainment of the proper proportion of lime or lime-water to be used, so that the water shall neither retain too much of its original hardness nor acquire an unpleasant taste and astringent action from an excess of lime. This can, however, be done quite readily by a few tests with different proportions of lime-water, and the very simple trial as to which will produce the least "curdling" of soap when ready-made soapsuds are added in small proportion. Whatever proportion of lime-water or lime satisfies this easily ascertained condition, is the best for all purposes.

Numerous experiments prove that for the waters of the wells,

springs, and smaller streams, as well as the catchment reservoirs of the middle coast ranges and their valleys, the best effect is usually produced by the addition of from one-tenth to one-twentieth of clear lime-water.

As one part by weight of pure, unslaked lime requires seven hundred parts of water for its solution, a simple calculation shows that the above proportion corresponds to from five to eight grains of lime per gallon, or about three-quarters to one pound per thousand gallons.

In the practical working of this process it is best to have, for small tanks up to one or two hundred gallons, a supply barrel in which clear lime-water of full strength can always be kept on hand ready for use. A few pounds of lime, slaked into a creamy mass, may be put in the barrel, the sediment being stirred up from time to time as the clear water standing over it is replaced. Of course, in order to preserve the proper proportion, once determined, only clear water must be used, otherwise more lime than is called for, will be introduced into the water. The lime-water barrel should be kept closely covered.

For larger tanks it will be more convenient either to take a weighed amount of unslaked lime for each one thousand gallons, slack it into milk-of-lime and stir it in, or else to prepare a large quantity of milk-of-lime which, when thoroughly stirred, will for each measure (bucketful) contain a known amount of lime. This would be the best way to handle cases in which the feeding water of boilers requires to be corrected. It should, in this connection, be understood that the lime treatment is very efficacious against the frothing produced in boilers by waters containing a large amount of vegetable matter, as is commonly the case in that from ponds or other catchment reservoirs.

The sediment that accumulates in tanks used for this treatment is usually of a sandy nature, and not readily stirred up; it therefore causes little inconvenience, and can be removed at leisure, from time to time, as it becomes too large.

It is true that, like some other household measures conducive to sanitation and comfort, the maintenance of this system requires some regular personal interest and attendance on the part of some member of the family. If carelessly handled, there may be unaccountable variations in the gastric conditions of the family, from one extreme to the other, and the soap may curdle from the water's natural hardness one week, and from excess of lime the next. But there is no excuse for such occurrences, except as the result of carelessness or negligence, and the advantage gained, whether as to health or comfort, amply repays the trouble when these hard waters require to be used.

A NOVEL ELECTRIC BATTERY.

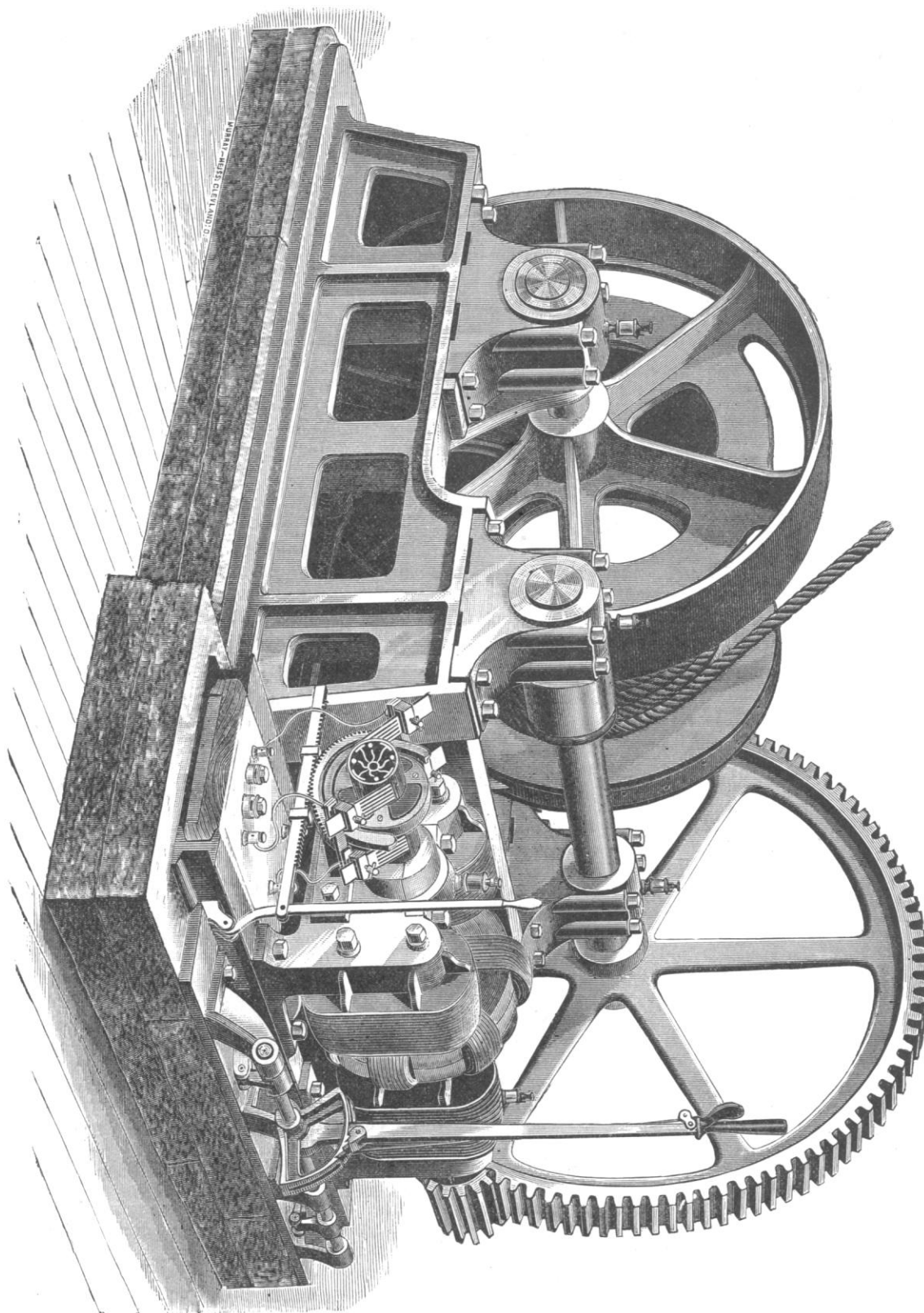
A NOVEL and simple form of electric battery has recently been invented in Italy. As described in the *Rivista Technica*, it consists of conical vessels of cast iron and porous earthenware, with nitric and sulphuric acid. An iron cone is placed point downwards in a stand, and is partly filled with strong nitric acid. Into this there is placed a cone of porous earthenware containing dilute sulphuric acid. Then follows an iron cone surmounted by an earthenware one, and so on in a series, each vessel containing its respective acid. It follows that the inner surface of each iron vessel is bathed in nitric acid, and becomes passive, acting the part of the platinum or carbon in an ordinary cell. The outer surface is attacked by the dilute sulphuric acid, and takes the place of the zinc. There are no connections to make, the simple building of the pile putting all the parts into union. The earthenware cones are eight inches in diameter and four inches in height, and contain five hundred and fifty cubic centimetres of ten per cent sulphuric acid solution. The iron vessel contains one hundred and ten cubic centimetres of nitric and sulphuric acids, the latter being three times the volume of the former. Sixty elements, arranged in two piles, have a resistance of ten and one-half ohms, an electromotive force on open circuit of eighty-one volts, and on closed circuit of forty-five volts, with a current of four and four-tenths ampères. After five hours the difference of potential falls to twenty-eight volts and the current to two and seven-tenths ampères.

THE BRUSH ELECTRIC HOIST.

A COMPACT combination of an electric motor with a winding-drum, for hoisting purposes, is shown in the engraving on this page. The motor, which is of the well-known Brush make, is of

cess of the Brush Company's electric plant in the Chollar mine, which was illustrated and described in *Science* some months ago, has resulted in attracting the attention of the company to the vast field for the use of electric power in mining operations; and this electric hoist is an attempt to supply the demand that is already

BRUSH ELECTRIC HOIST FOR MINING AND OTHER PURPOSES



fifteen horse-power, and is mounted on the same base as the hoisting-drum, which is of the Walker pattern. A gear pinion on the armature shaft meshes with the large gear-wheel, which in turn actuates the winding-drum by means of friction pulleys. The suc-

cess of the Brush Company's electric plant in the Chollar mine, which was illustrated and described in *Science* some months ago, has resulted in attracting the attention of the company to the vast field for the use of electric power in mining operations; and this electric hoist is an attempt to supply the demand that is already

OLIVE CULTIVATION.

OF the various food products, or vegetable liquids, perhaps those most extensively shown at the Paris Exhibition are wine and oil. These two seem to follow the progress of civilization and settlement, whenever the climate is suitable. Olive oil is shown in a very large number of the foreign sections, and the wide and extensive progress it has made over the world is exemplified now by one French exhibitor, who exhibits samples from the following widely-separated districts: the Gold Coast of Africa, Melbourne and Adelaide, Chili, Guatemala, Guayaquil, Mexico, Venezuela, La Plata, New Orleans, Philadelphia and New York, Canada, India, Cochin China, Reunion, Mauritius, Japan, Polynesia, Havana, Guadaloupe, Martinique, Trinidad, Hayti, the Black Sea coast, the Levant, Spain, Portugal, and France.

But these are not all the seats of production, and are merely cited to show how widespread is the culture of the olive at the present day.

Taking the French official catalogue, and turning to the alimentary products, "class 69, oils and fatty substances," there will be found over six hundred exhibitors of olive oil specially named, besides numerous collective exhibits, and many others also are included under the general term "comestible" or edible oils. There is much substitution, however, carried on in this respect at the present day by the sale to the public of refined cotton-seed oil, sesame, and other oils, in place of olive oil. The number of exhibitors of olive oil under each country as given by Mr. P. L. Simons in the *Journal of the Society of Arts*, are as follows: Portugal, 448; Algeria, 128; Italy, 8; France, 12; Spain, 5; California, 4; Japan, 1; total, 606. There are two or three exhibitors also from Tunis, and in the French section there is a collective exhibit of edible oils made by sixty-seven producers and dealers from Salon, Bouches du Rhone.

The various uses of the olive for its fruit and its oil are well known. In ancient Greece the tree received all the honors, and had almost a sacred character. This was in consequence of its being the chief production of the country, and its produce the main source of public food.

From olden times the people of the Mediterranean coasts have made the olive their principal culture, and it is there the oil industry chiefly centres, — in Spain, Portugal, Italy, Greece, and France, on the northern coast; and Morocco, Algeria, and Tunis, on the southern shores.

The olive has been cultivated in those regions from time immemorial, as the bounteous gift of heaven and the emblem of peace and plenty. Olive oil takes there the place of butter. Spain has about 3,000,000 acres under olives, Italy 2,250,000, and France about 330,000, of which 15,000 acres are in the district of Nice. Olive oil in the country of Nice forms now four-fifths of the agricultural produce.

The varieties of the olive are very numerous. The naturalist Risso, in 1826, described forty distinct varieties, and these have since been increased to forty-five.

In the countries where it is indigenous, the olive tree attains gigantic proportions. It reaches, occasionally, sixty feet high, with a circumference of trunk of twelve feet, and these trees are supposed to have attained the age of one thousand years. Certain varieties grow more rapidly than others, and some differ from each other in the nature of the wood, the foliage, and the quality of the fruit. There are large olives and small olives, pointed, oval, round, and curved fruit, and of all colors, ranging from white to black, and from green to red. The flavor of the fruit is mild, sharp, or bitter. Hence, according to the variety, there is obtained sweet oil, light colored, and of exquisite flavor, up to dark green, thick, and of a bitter taste, strong and very unpleasant to the palate. Hence it follows that olive oil can be obtained pure, and also quite unfit for food purposes, only suitable for greasing machines and making soap. The green unripe olives, after remaining in a solution of salt for some time, to remove the bitter taste, are preserved in vinegar, with spices, in bottles or small barrels. Those of Tuscany and Lucca are considered the best, on account of their light-green color and strong flesh. In all parts of southern Europe they are in this form a daily food.

The ripe olives are gathered in the fall, when they are as large as common plums; their color is dark green, and the soft kernel has changed into a hard stone, which contains a savory almond. The flesh is spongy, and its little cells are filled with the mild oil, which pours out at the least pressure.

There is a fine collection of preserved olives shown by Hernanos & Company, of Barcelona. The finest oil is the so-called virgin oil, to obtain which the freshly gathered olives are put into little heaps, and by their own weight the oil is pressed out, and is caught in some vessel. It is clear like water, has a delicate nut-like taste, with little or no odor. When the fruits cease to give the oil by themselves, they are pressed with small milkstones. The oil gained by this process is also clear, and of a pleasant taste.

After this treatment the olives are still rich in oil, and the fruits are put in sacks; boiling water is poured over them, and they are pressed once more. The oil gained by this process is yellowish green, and has a sharp taste and an unpleasant smell, because it contains some mucilaginous matters.

At Marseilles, the great seat of the vegetable oil trade, the olive oils are classed into manufacturing oils for burning, for greasing machinery in factories, and for soap-making; refined oil; oil from the pulp or husks; and table or edible oil. The latter is divided into superfine, fine, half-fine, and ordinary. The table oil is refined by allowing it to run through layers of thin sheets of wadding into tin perforated boxes; the wadding absorbs all the thick particles, and leaves the oil perfectly clear and tasteless.

In the Spanish section, Signor José Gonzalo Priete, who has steam works at Lora del Rio, Seville, makes a display of an imitation olive tree silvered, from the branches of which are suspended six glass globes, filled with the different qualities of pure olive oil.

The Tuscans were the first who exported olive oil largely, and thus it has obtained the name of Florence oil. It would be a curious fact to ascertain the number of olive trees which exist in the different countries bordering on the Mediterranean, — Tunis has over four millions, Algeria three millions, Nice one million, Syria several millions, while the number in Spain, Portugal, Italy, Greece, Morocco, and Turkey is unknown.

The Union of Proprietors of Nice is a limited society, with a capital of about a hundred thousand dollars, which, by its statistics, binds itself to deal only in pure olive oil. It has about twenty-six plantations and presses in different parts of the district. The company makes a fine display of olive oil.

It may be stated, in conclusion, that the olive crop is a very variable and uncertain one; one that yields a profit does not perhaps occur for six or eight years.

HEALTH MATTERS.

Report of the Paris Commission on Consumption.

THE permanent commission, appointed last year by the Congress for the Study of Tuberculosis, has just presented its report, through M. Villemin, chairman. This report embodies certain instructions to the public, which the commission deems of sufficient importance for general adoption. *The Boston Medical and Surgical Journal* summarizes this report, a comparison of which with that issued in New York, and previously referred to, is of interest.

Tuberculosis is, of all diseases, that which has the most victims, especially in the cities. More than one-fourth of the mortality of Paris during the year 1884 was from tuberculosis in some of its forms. Tuberculosis is a parasitic, virulent, contagious, transmissible disease, caused by Koch's bacillus. The microbe penetrates the organism by food, by air of respiration, and through the skin and mucous membranes by abrasions, excoriations, and divers ulcerations. Certain diseases, as measles, chronic bronchitis, pneumonia; certain constitutional states due to diabetes, alcoholism, syphilis, predispose to tuberculosis.

The cause of tuberculosis being known, there is but little difficulty in preventing its dissemination and propagation, if proper prophylactic means are taken. The parasite of tuberculosis may infect the milk, muscles, and blood of animals which serve for the food of man. Raw meat, underdone meat, blood, may contain the living germ of tuberculosis, and should be interdicted. For the same reasons, milk should be boiled before being ingested. By

reason of the dangers which attend the use of raw milk, the protection of young children, who are so susceptible to tuberculosis, should earnestly engage the attention of mothers and nurses.

By reason of the dangers which attend the use of butchers' meat, which may come from animals that were tuberculous, though having every appearance of health, the public should insist that the inspection of all meats, as required by the law, should be rigorously enforced. The only sure way of avoiding the dangers arising from meat derived from tuberculous animals, is to subject such meat to a thorough cooking, which shall include the entire substance in depth, as well as the surface. Meats completely roasted, boiled, or broiled are alone safe.

As the germ of tuberculosis may be transmitted from the tuberculous to the healthy man, by sputa, pus, dried mucosities, clothing, or other objects impregnated with fine tuberculous particles, it is necessary for the public, in order to be protected against the contagion:—

(1) To know that, the sputa of phthisical patients being the most formidable agents of the transmission of tuberculosis, there is danger in allowing these expectorated matters to be deposited on the ground, on carpets, on drapery, screens, towels, handkerchiefs, clothing, and bed linen.

(2) To be persuaded that the use of spittoons is obligatory on all phthisical patients everywhere. Spittoons should always be emptied into the fire and cleansed with boiling water. They should never be emptied on dung heaps, on garden soil (where they may tubercularize fowl), nor into privies.

(3) To refrain from sleeping in the bed of a tuberculous patient; to remain as little as possible in a room occupied by such person. This caution is especially applicable to young children.

(4) To sequester from all places occupied by phthisical patients, individuals considered as predisposed to tuberculosis, children born of tuberculous parents, or that have lately had measles, small-pox, pneumonia, etc., and all diabetic patients.

(5) To avoid using objects which a phthisical patient may have contaminated—garments, bed-clothing, toilet-implements, playthings, etc.,—till after previous disinfection, in the hot-air stove, by boiling water, sulphur fumigations, etc.

(6) To insist that the rooms of hotels, furnished houses, cottages occupied by phthisical patients at watering-places or winter stations, shall be equipped and tapestried in such a way that disinfection may be easily and completely effected after the departure of each patient. It would be better that these apartments should have no hangings or tapestry, and that they should be whitewashed. The floors should be bare, either oiled or painted. Hotels and furnished cottages in which such hygienic precautions and measures of disinfection are taken should alone be patronized by the public.

At the meeting of the Academy of Medicine, Aug. 6, 1889, this report was discussed. Dujardin-Beaumetz was in favor of suppressing entirely the sections pertaining to raw meat and raw milk. There is nothing that proves the possibility, in man at least, of the transmission of tuberculosis by butchers' meat. As for milk, if it be true that it may on certain occasions contain bacilli, we must not forget that in order that milk may be thus contaminated the cow must not only be tuberculous, but must also have tuberculous mammitis.

Germain Sée did not believe in the communication of tuberculosis by the air of respiration. The bacillus cannot live in the air. It never develops and multiplies outside of the organism of man or the animal. In the open air it dies rapidly, as, in order to live, it needs a temperature of 30° C. The matter of atmospheric contagion is a bugaboo, which has already wrought trouble in families by causing the poor consumptive to be treated like a leper,—shunned and abandoned by his nearest relatives. It has been demonstrated experimentally that air taken three or four yards from the bed of a consumptive patient does not contain a single bacillus; but if the air exhaled by a phthisical person is inoffensive, the sputa are not so, and too much pains cannot be taken to disinfect and destroy all expectorated matters.

With regard to the prohibition of meat and blood, it is a fact, said Professor Sée, that the blood is never virulent, and animal flesh, according to recent experiments (Nocard, of Alfort), far from containing bacilli, destroys them by the muscular juice which the

flesh contains. Hence, there is no necessity, in order to destroy the bacillus, to boil meat to a pap, to forbid roast meat, or underdone meat, or even raw meat. If we were to hearken to the commission, he thought we should be deprived of some of our best alimentary products, and nothing would be served on our tables that was not spoiled to the taste by over-cooking, as well as rendered more indigestible thereby.

With regard to the care that should be taken of those that were hereditarily predisposed to tuberculosis, he thought that excessive precaution was an evil; the best prophylactic is gymnastic exercises and hydrotherapy.

Professor Sée did not think persons especially liable to tuberculosis, who had been subject to colds, bronchitis, or who had had pneumonia, measles, whooping-cough, or small pox. On the contrary, he had found such persons remarkably exempt from tubercular diseases.

Tuberculous Meat.

Simultaneously with the report of the permanent commission of the French congress on tuberculosis, says the journal before quoted, we have before us a voluminous report from Glasgow, giving the proceedings at trial, under petitions of the Glasgow local authority, against two butchers who exposed for sale, for human food, the carcasses of two tuberculous animals. Among those giving testimony at the trial we find the well-known names of Dr. J. B. Russell, medical officer of health for Glasgow since 1872; Joseph Coats, pathologist to the Royal Infirmary of Glasgow, and Professor J. McCall, Principal of the Glasgow Veterinary College. In addition, there were the medical officers for Edinburgh and Greenock, and for Leeds, Birmingham, and Hull; three other veterinary pathologists besides McCall; and Mr. Mayland, as a bacteriologist and pathologist in addition to Dr. Coats. There were, in all, fifteen witnesses for the prosecution and nineteen for the defence. The conclusions of the French congress, as well as of the Brussels veterinary congress of 1883, and of a departmental committee of the privy council, were frequently referred to in the course of the testimony.

The cases were test cases, brought to enable the medical officers of Glasgow to apply the same stringent standards as were already enforced in Edinburgh and Greenock.

The evidence showed that, in regard to one of the animals, "there were tubercles in the substance of the lungs themselves, in both the costal and pulmonary pleura, in the pleura connected with the diaphragm, and further in the cavity of the body inclosing the respiratory organs;" there was tubercular deposit in the lymphatics, and tubercular bacilli were found in the inguinal gland. In regard to the other, it was shown that there was active tuberculosis in the lungs and pleura, and bacilli were found in the prepectoral gland. The question before the court was, whether the meat of these animals after the carcasses had been "stripped" was "unfit for the food of man."

The prosecution laid down five propositions, and asked for conviction upon their acceptance by the court. (1) The disease called tuberculosis, whatever form it may assume, whether phthisis, or scrofula, or struma, is a widespread disease amongst animals and man, and to it may be attributed a large percentage of the deaths in the community, and a very large proportion of the ill health. (2) That the disease known as tuberculosis now, is identical in man and in the lower animals. (3) The disease is communicable from the lower animals to man, by, amongst other means, inhalation and ingestion. (4) The disease tuberculosis is due to the active presence of a specific organism known as the bacillus tuberculosis. (5) Given the signs of tuberculosis upon certain specific organs of an animal, you may and ought reasonably to infer that the virus of the disease is in other portions of the carcass of the animal, where there may be no outward and visible signs to indicate its presence.

The defence held that no one has ever yet heard of a case of tuberculosis contracted from the ingestion of tuberculous meat; but in the case of milk, the disease has been traced, and if in the latter, why not in the former; that cooking was a sufficient safeguard, and if people preferred to eat partially cooked meat, they should be allowed to take whatever infinitesimal risks might exist; that, even

when the bacillus enters the alimentary canal, there must be a degenerated condition of the tissues before it can find lodgment and fructify; that to a healthy person, therefore, the danger is perfectly visionary; that the alimentary canal is the least favorable channel for entrance into the system; that the disease in these cases was so localized as not to affect the flesh in general; that, in any case, the danger to health and life must be extremely small, too small to justify the exclusion from the market or destruction of large amounts of good, wholesome food.

The prosecution pointed out the inherent difficulty of proving, as a matter of fact, and not merely as a matter of opinion, the actual communication of tuberculosis to human beings by the ingestion of the flesh of tuberculous animals; and adduced evidence that the flesh of animals affected with tuberculosis, more or less, and offered for sale for food in Glasgow, is one half per cent in the year.

In summing up the evidence and the arguments, the court held that whether ingestion be or be not the commonest way in which tuberculosis is communicated, it must certainly be regarded as one mode of its communication; except on the footing that the meat was the medium of the transmission of the disease, it would be unnecessary and wasteful to exclude from the food-supply the carcasses of animals suffering from tuberculosis, however generalized and extensive; but the previously existent practice in Glasgow and elsewhere of condemning extensively diseased animals, clearly showed that the transmissibility of the disease by ingestion had long been recognized, and the evidence leads to the conclusion that it would not be proper to trust to cooking as a sufficient protection; that every animal suffering from tuberculosis, however limited in degree or apparently in locality, probably ought to be condemned, and that such condemnation would not cause a loss of food of more than one-quarter of one per cent; but, in the present instances, the disease, having extended to the lymphatic glands, was undoubtedly generalized.

The number and character of the witnesses, the clearness of statement of the counsel, the respectability of the court, and the Scotch reputation for shrewd, practical common sense, give the report and result of this trial a considerable interest, as bearing upon the present position of science and practice in regard to the questions involved. Should it ultimately appear, as we see by the published abstract of a paper, to be read at the approaching meeting of the Association of American Physicians, Dr. H. C. Ernst thinks he is in a position to prove, that the milk from a cow suffering from tuberculosis is dangerous as an article of food, no matter where the pathological change may be situated, and that Koch's limitation of the danger to tuberculosis of the lacteal tract was too restricted, then the position of those who condemn the meat, even of locally infected animals, would be greatly strengthened.

THE AIR IN EDINBURGH THEATRES.—An interesting account has been given by Mr. Cosmo J. Burton of the amount of carbonic acid and organic matter in Theatre Royal and Royal Lyceum Theatre in Edinburgh. At the time of the experiments the theatres were by no means full; nevertheless, the temperature was from ten to fifteen degrees above that recorded immediately before the houses were opened, while carbonic acid was multiplied from three to five times. Mr. Burton remarks, as quoted by the *Lancet*, that the vitiation of the air proceeds with extraordinary rapidity at first, but the rate of change soon decreases, till towards the end of the performance the air becomes little or no worse, and, indeed, in a few instances it appeared to slightly improve. The atmosphere of all parts of the theatre was not equally vitiated. The air of the gallery was considerably worse than that of any other part of the house; the amphitheatre, dress circle, and pit did not come in the same order as to degree of impurity in the experiments, but the pit was always worse than the dress circle. The late Dr. Parkes stated that headache and vertigo are produced when the amount of carbonic acid in the air of respiration is not more than from fifteen to thirty volumes per ten thousand, and the experience of some theatres leads to the suspicion that Mr. Burton's results are not special to Edinburgh. The facts as to all theatres ought to be known; for the public had much better lose an evening's enjoyment than submit to the enforced inhalation of a polluted atmosphere for a number of hours.

NOTES AND NEWS.

It is stated by the *Scientific American* that carefully repeated experiments made by an English navigator at Santander, on the north coast of Spain, showed the crest of the sea waves in a prolonged and heavy gale of wind to be forty-two feet high; and allowing the same for the depth between the waves, would make the height eighty-four feet from crest to base. The length from crest to crest was found to be three hundred and eighty-six feet. Other estimates of the waves in the South Atlantic during great storms give a height of fifty feet for the crests and four hundred feet for length. In the North Sea the height of crest seldom exceeds ten feet and the length one hundred and fifty feet.

—At a recent meeting of the Paris Academy of Sciences, M. Benger described the curious effects of an electric discharge which struck a silvered mirror during a terrific thunderstorm near Prague, on June 9, 1889. The mirror shows over ten points at which the electric fluid penetrated through its gilded frame, volatilizing and transferring the gold to the anterior face of the glass, while on the opposite side the volatilization of the silver coating produced the most beautiful electric figures. These figures show that there occurred repeated and successive discharges, as also indicated by recent photographs of flashes taken with the oscillating camera obscura.

—In a recent letter from Paris to the *Engineering and Mining Journal*, Mr. George F. Kunz says it may be interesting to know that the following minerals are exhibited in and are for sale in quantity in the Norwegian section of the Paris Exposition at the following rates per pound: Molybdenite, 32 cents; Gadolinite, \$2.54; Zircon, \$1.27; Cerite, 32 cents; Orthite, 13 cents; Rutile, 20 cents; Thorite, \$10.54; Yttrotitanite, 20 cents; Columbite, 94 cents. In reference to the occurrence and the use of vanadic and molybdic acids, both of these acids have until recently been considered rare. Since they, however, replace phosphoric acid in the lead ores of New Mexico and Arizona in the minerals wulfenite, vanadinite, etc., which exist there in quantities, they can be obtained at much less cost than they could before.

—"The great development in electricity will be, I am firmly convinced," said Mr. Edison to an interviewer in Paris, "in discovering a more economical process of producing it. At present we only get from coal consumed about four or five per cent of its latent electricity. The rest is wasted in heating water, expanding steam, pushing pistons, turning wheels, and finally causing a dynamo-machine to operate. A process will ultimately be found for extracting ninety to ninety-five per cent of the latent electricity directly from the coal. Then steam engines will be abolished, and that day is not far off now. Already we can get electricity direct from coal to the amount of ninety per cent, but only for experimental purposes. When I was on shipboard coming over I used to sit on deck by the hour and watch the waves. It made me positively savage to think of all that power going to waste. But we'll chain it up one of these days, along with Niagara Falls and the winds. That will be the electric millennium."

—It is stated in the *Metallarbeiter* that iron can be coppered by dipping it into melted copper, the surface of which is protected by a melted layer of cryolite and phosphoric acid, the articles to be thus treated being heated at the same temperature as the melted copper. Another process consists in dipping the articles into a melted mixture of one part of chloride or fluoride of copper, five or six parts of cryolite, and a little chloride of barium. If the article, when immersed, is connected with the negative pole of a battery, the process is hastened. A third method consists in dipping the articles in a solution of oxalate of copper and bicarbonate of soda, dissolved in ten or fifteen parts of water, acidified with organic gas.

—If London is the metropolis of the land of fogs, there is much consolation to be found in the fact that in spite of its smoke and its fogs it is not only one of the healthiest cities in the world, but is growing healthier every year. According to the official statistics for the quarter ending June last, as stated by a leading London newspaper, the annual deaths are only at the rate of sixteen per thousand. If some overcrowded and notoriously unhealthy dis-

tricts could be eliminated from the calculation, the figure would, of course, drop considerably. Still more remarkable would the sanitary condition appear if the area were confined to the high and airy suburbs in which so large a proportion are fortunate enough to dwell. Londoners have only to contrast this condition of things with the statistics of other capitals, to see how great is the advantage they enjoy. In Paris, which shows a comparatively good record, the mean annual death-rate is 32.1; in Berlin it is 27.5; in Vienna, 26.7; in Munich, 32.9, and in St. Petersburg, 43.7. In Brussels, which appears to be the healthiest of continental cities, it is 18.9. To sum up the case, the death-rate during the quarter in twenty-nine colonial and foreign cities, having an aggregate population exceeding 16,000,000 persons, was 26.6 per 1,000, or more than 10½ persons per 1,000 in excess of the London death-rate.

— The Iowa Academy of Science held its third annual meeting at West Des Moines on Sept. 5. Among the papers presented were the following: "Life History of *Lelandria ignota*," by Mr. F. W. Malley; "The Blue Quail in Iowa," "The Mission of Science," and "Notes on the Geology of North-western Iowa," by Professor J. E. Todd; "Fossils of the Keokuk Beds," by Professor C. H. Gordon; "Pearl Rearing Unios" and "Rearing *Vanessa antiopa*," by Professor F. M. Witter; "Native Forest Trees of Eastern Arkansas" and "Geology of Eastern Arkansas," by R. Ellsworth Call; "Geology of North-eastern Iowa," by Dr. P. J. Farnsworth; "Notes on Beggiatoa," by Professor L. H. Parmmel; "Distribution of Hemiptera," by Professor Herbert Osborn; "Is the Plum *Curculio* double-brooded?" by Professor C. P. Gillette; "The Food-fishes of Iowa," by Professor Seth E. Meek; and "The Crystalline Rocks of Missouri," by Professor Erasmus Haworth. Professor Todd also exhibited some volcanic dust from a stratum near Omaha.

— Schemes for irrigation in Upper Egypt have been considered by Colonel Ross, inspector-general of irrigation, with the governors of the provinces and the provincial councils. According to *Engineering*, the area affected by these proposals includes 736,000 acres, of which no less than 250,000 acres were not irrigated or were insufficiently irrigated in 1888. The projects are all based on the idea of going up the river to such a distance that a canal starting at that point shall, when the Nile is at fourteen cubits, take enough water and deliver on the surface a free flow. The present system of canals is being utilized by deepening, widening, and prolonging them, and in many cases only by a change of site of the offtake from the river. The masonry works required will, it is estimated, cost about \$900,000, of which \$500,000 is required immediately. The junctions and prolongations of canals are estimated to cost about a million dollars. The length of the valley to be thus protected from the effects of a low Nile is 255 miles.

— Mr. William Crookes, in the course of a presidential address to the Chemical Society, said: "The phosphoroscope affords another method of verifying the simple or compound character of a substance. It is well known that the continuance of phosphorescence after the cessation of the exciting cause varies widely, from some hours, as in the case of the phosphorescent sulphides, to the fraction of a second in the case of uranium glass and quinine sulphate. On examining phosphorescent earths glowing in a vacuum tube under the action of the induction discharge, I found remarkable differences in the duration of this residual glow. Some of the earths, after the cessation of the current, remain luminous for an hour or more, whilst others cease to phosphoresce immediately on the stoppage of the current. Take the case of yttrium. As already stated, I succeeded in resolving this earth into several simpler bodies not equal in basicity. While seeking for further proof of the distinct character of these bodies, I observed that the after-glow differed somewhat in color from that which the earth exhibited whilst the current was still passing. Further, the spectrum of the after-glow seemed to show, so far as I could judge by the faint light, that some of the lines were missing. As this phenomenon indicated another difference among the components of yttrium, I examined them in an instrument similar to Becquerel's phosphoroscope, but acting electrically instead of by means of direct light. Under ordinary circumstances it is scarcely possible to perceive any phosphorescence in an earth until the vacuum is so high that

the line spectrum of the residual gas begins to grow faint. Up to this point, the stronger light of the glowing gas overpowers the feeble glow of the phosphorescence. But in the phosphoroscope the light of the glowing gas lasts only for an inappreciable time, while that of the phosphorescent earth persists long enough to be distinctly observed. The different bands of the new constituents of yttria do not all appear at the same speed of rotation. At the lowest speed the double greenish blue band of $G\beta$ is first seen, followed next by the dark blue band of $G\alpha$. As the velocity increases, there follows the bright citron-yellow band of $G\delta$, and as the utmost speed approaches the red band of $G\zeta$ is seen, but with difficulty. If lanthanum sulphate along with a little lime is examined in the phosphoroscope, the line of $G\epsilon$ is visible at the lowest speed; $G\delta$ follows at an interval of 0.0035 second, and the $G\alpha$ line immediately afterwards."

— Professor Frank D. Adams, having been appointed lecturer on geology in McGill University, Montreal, is about to sever his connection with the Geological Survey of Canada.

— A most interesting exhibit at the Paris Exposition, according to *Engineering*, is a recording flash telegraph for military or other purposes. This apparatus, which is exhibited by MM. Ducretet, is in fact a combination of a flashing telegraph and a Morse printer, consisting of a projector fitted with a powerful lamp in the focus of the usual optical apparatus. In front of the lamp and below it and the lenses is a screen, which may be suddenly removed from the front of the lamp by the depression of a key similar to that in use under the Morse system, and this screen may be as suddenly replaced by the release of the key; the flashes, long or short, are therefore transmitted to the distant station by the action of the key exactly in the same way as in transmitting a Morse message. The movement of the key has, moreover, a second action, for it sets into motion or stops the Morse recorder, doing mechanically exactly what the electric current does in the ordinary form of that instrument. As long as the key is depressed a beam of light is continuously projected to the distant station, and a continuous line is drawn on the paper band, and the moment that the key is released the light is obscured, and at the same time the recorder ceases to draw a line on the paper. Thus every flash, whether short or long, as well as the periods of rest, are accurately recorded on the band of paper, and a permanent record is produced of every message flashed through the instrument.

— The "chemin de fer glissant," or sliding railway, at the Paris Exposition, says the *Engineering and Mining Journal*, is the application in practice of an old theory that, by adopting a sled upon rails with water interposed as the carrying medium, the least possible friction would be encountered and greater speed could be attained than by means of wheels. The promoters of the enterprise give the credit of the invention to a French engineer named Girard, who was killed in the Franco-German war, and name as the date of it 1868; but, if we are not mistaken, the idea was advanced some years before this date in England, where it was looked upon as chimerical and impracticable. However that may be, it has now for the first time been tried on a working scale, and in combination with a system of propulsion which, we believe, is novel. The wheels are replaced by four hollow slides, about eight by four inches, one at each corner of the car, fitting upon a flat and wide rail, grooved on the inner surface. To set the car in motion, water is forced by compressed air into the slide, which it raises slightly from the rail, and the propelling force is supplied by a stream of water at high pressure directed from short iron pillars upon paddles fixed underneath the car. The stream of water is supplied automatically by the movement of the car, being shut off in the same manner by the paddle passing out of range. By the time the last car has passed the jet the foremost one has reached the next pillar. The force developed is represented as very great. The train is stopped by shutting off the stream of water that feeds the slides. The experimental line on the Esplanade des Invalides has four carriages, with seating capacity for about a hundred passengers, and to traverse its length, some two hundred and fifty yards, only a few seconds are required. Great speed is claimed for the invention, not less than about ninety miles an hour, and the ability to stop in thirty yards when running at this speed. Gradi-

ents are represented to be no obstacle, sixteen inches in the yard being practicable, and the descent at such an inclination is said to be safe. No doubt the lowness of the centre of gravity, which is little more than two feet above the rails, will reduce the risk of running off the track, but the enthusiastic recommendation of the system by its promoters as peculiarly adapted for elevated railways in cities would not be echoed, we think, by the dwellers and foot passengers in streets traversed by such a line. We do not see how a continual shower bath is to be avoided, except by such an extensive, expensive, and above all, opaque dripping pan as would both require an immense expenditure and create an intolerable nuisance.

—According to the *Journal of Chemical Industry*, the specific gravity of glycerine when used for tempering steel or cast iron may be varied between 1.08 and 1.26 at 15° C. by adding water, according to the composition of the metal. The quantity of glycerine should be from one to six times greater than the weight of the pieces to be plunged into it, and its temperature may be varied from 15° to 200° C., according to the hardness of the metal. The harder the steel to be tempered, the higher should be the temperature of the glycerine. To increase the quenching power of the bath various salts may be added. Thus, when a harder temper is required, protosulphate of magnesia may be added in quantity from one to thirty-four per cent of the liquid, or from one-fourth to four per cent of sulphate of potassium. For a softer temper one to ten per cent of chloride of manganese and one to four per cent of chloride of potassium may be added. The principal advantages to be derived from these methods are: that the temperature of the aqueous solution of glycerine may be varied within wide limits, the boiling point of pure glycerine being 290° C.; and that, owing to the fact that solutions of glycerine dissolve most salts that are soluble in water, the quenching properties may be varied by readily dissolving in the bath such salts as suit the kind of metal to be tempered and the degree of temper required.

—The *Gardeners' Chronicle* reports that at the Paris Exposition many of the South American republics show specimens of the product known locally as *yerba de mate*, or Paraguay tea, the dried and broken leaves and stalks of different species of *ilex*. It is exhibited in packets and in original bales of green hide. This is the dietetic beverage of about 20,000,000 of people in South America, and its popularity is shown by the exhibits in the various pavilions of the Argentine Republic, Paraguay, Uruguay, Brazil, Chili, Bolivia, etc. It is difficult to get at any reliable returns as to the entire traffic in this commodity, the production of which is carried on in such a desultory and wide manner, and extends over so vast an area of wild country where the holly-trees flourish. In the Argentine Republic the consumption is over thirty-five million pounds, against five million pounds of coffee. In Paraguay the production of mate is about five million pounds; from Brazil there is an export of sixty-five million pounds to neighboring States, while the local consumption is about half as much. This is singular in the great coffee-producing centre of the world, which sends into commerce annually more than half the entire production of coffee. Strong efforts are being made to open a trade with it in Europe, especially in France, where shops advertise and recommend it. Whether this will succeed remains to be seen, looking at the increased production of tea, and the enormous increase in its sale in Europe. Approaching in its chemical composition to coffee and tea, it is asserted that it does not cause wakefulness or prevent sleep. In the rural districts, as well as in the smaller towns, this beverage is considered a regular form of diet, and not, like tea, a mere accompaniment of the breakfast-table. It is sweetened with sugar until it almost becomes a syrup. It is sold at from four to eight cents per pound, and one pound will produce about twenty quarts of infusion. It is sometimes flavored with cinnamon, orange-peel, or lemon-juice.

—At Cambridge, England, during the month of August, about twenty elementary teachers were in residence for a brief visit at Newnham College, and short courses of lectures were started in history, literature, and physiology, which might serve as a useful kind of university extension on a small scale. Full advantage was taken of the interesting lectures in history, literature, physiology, logic, and other subjects. The lecturers and students vied with

each other in making their visitors' holiday as happy as possible, arranging walking and boating excursions, impromptu concerts, tea-parties, and other forms of entertainment for them. The so-called old hall, the oldest of the three halls which now form the college, was given up to the visitors, who were under the care of two lady lecturers. The pretty rooms and tasteful decorations, the quiet and beauty which form the charms of an academic life, will doubtless be pleasant memories to those whose ordinary work lies in less beautiful places. It has come to be understood that the university extension gathering will in all probability take place annually at Oxford. It appears that the facilities offered by the place, such as the new schools, the general emptiness of the colleges, etc., are much greater than at Cambridge, and that the number of ladies attending these gatherings is likely to increase in future years. As a means of drawing women together, and giving an impetus to education, these meetings have already proved of great value. They supply an enthusiasm and a desire for knowledge and culture which can only be obtained by the gathering together of teachers and students. The actual instruction given can, of course, hardly be of consequence; but for this purpose the second part of the meeting, extending to the end of the month, during which lecturers continued in greater detail the subjects introduced during Part I., was probably found by the fraction of students who remained for it to have considerable educational value. Mr. Moulton, Mr. Mackinder, Professor Green, Mr. Churton Collins, Mr. Shaw, and Mr. Hewins were the lecturers, who worked out in greater fulness the subjects which they had already dealt with in a more summary fashion. This summer meeting at Oxford was marked by an incident which may in time become quite famous. The debating hall at the Union was for the first time invaded by lady speakers. This is, indeed, a sign of the times, which he who runs may read. In an audience of six hundred a resolution in favour of women suffrage was carried by a majority of three to one. The proceedings took place without official sanction, and were tainted with the grossest illegality; but yet the roof did not fall, as doubtless it should have done had it retained a scrap of reverence for the monastic traditions of old Oxford.

—An interesting series of experiments has recently been carried out by the Dutch State railways, says *Engineering*, for the purpose of ascertaining exactly the relative resistance of various pigments to atmospheric changes and to the corrosive action of sea water. The results have proved that the red-lead paints are less affected by atmospheric influence than those which are composed of the brown oxides of iron, on account of their adhering more closely to the metal, and of their possession of greater elasticity. It was also discovered that any sort of paint afforded an increased protection if the plates were pickled in hydrochloric acid before its application. The prevention of corrosion by salt water was found to be possible by the admixture of the oxide of some electro-positive metal, such as caustic lime and soda; but the efficiency of such a covering diminished when its alkaline properties had been neutralized by the absorption of carbonic acid. Magnesia, however, was proved to be the most serviceable, seeing that it does not absorb carbonic acid; and not only does it protect the iron from galvanic action, but it also does not affect the anti-fouling qualities of the paint.

—In the report just issued by the Oxford University Extension delegates some interesting particulars are given, says the *Pall Mall Gazette*, of the devotion to learning under difficulties which some of the students display. Thus, at Camborne one of the students was a miner, who, after the evening lecture, had to go in the night shift underground. At Burnley, a weaver in a cotton-mill, in order to have more time for study, sacrificed her dinner-hour, and remained at the loom reading between her hours of work. To supplement the regular courses of lectures, and to carry on the work therein begun, an increasing number of reading circles and students' associations have, we see, been formed. Of the latter, one of the most successful is at Exeter. It consists of ladies only, and during the year it has held about twenty meetings for the discussion of literary subjects and the readings of essays, besides arranging for the delivery of ten special scientific lectures. The

movement has received an additional impetus from the generosity of the Marquis of Ripon, Mr. J. G. Talbot, M.P., Mr. F. D. Mocatta, the Rector of Exeter, and other donors, who offered scholarships, lately awarded, to enable poorer students to attend the summer meeting at Oxford.

— Some curious facts bearing on the *morale* of the lower animals are given by a correspondent of the *Revue Scientifique*. One source of animal sociability is a permanent sexual friendliness, making individuals mutually agreeable. Thus in stables without stalls, it is desirable to put animals of opposite sex next each other, to avoid injuries. A mare may be safely put into a field containing a horse unknown to it, but if two unacquainted horses be thus put together they will fight. A stallion, indeed, will sometimes get injury from an unknown mare put into a field with it. Again, the authority of the oldest and strongest in a group of males often favors sociability. In the Spanish *ganaderías*, a horseman will lead about a numerous troop of bulls, by means of five or six bulls who obey him and maintain order. In the Madrid circus the writer saw three of these animals bring to its stall a vicious bull which had ripped up five or six horses and mortally wounded an *espada*. They made a slight movement of the horns, and the creature, after a little hesitation, turned and followed them. Once more, when flocks of wild ducks and geese have to go long distances, they form a triangle to cleave the air more easily, and the most courageous bird takes the position at the forward angle. As this is a very fatiguing post, another bird, ere long, takes the place of the exhausted leader. Thus they place their available strength at the service of the society.

— A recent number of the *China Review* contains a paper by Dr. Macgowan on the alleged avenging habits of the cobra in Indian and Chinese folk-lore. The belief in India is that a wounded cobra which escapes will sooner or later revenge itself on the man who has caused the injury, wherever he may go or whatever he may do. Dr. Macgowan says that this belief is prevalent in Indo-China and China as well as in India. But in China there is also a strong prejudice against killing the cobra, lest its spirit should haunt the slayer ever after. Cobras, therefore, are shunned rather than pursued and attacked. Popular stories of the dire consequences of slaying them keep up the superstition. A high official who had killed one died soon afterwards of some mysterious disease, and the death is attributed to the slain snake; again, the spirit of the snake enters into possession of its slayer, and employs the vocal organs of the latter in uttering imprecations on himself until death mercifully removes him. Dr. Macgowan gives a large number of stories of this character. A number of others refer to the retribution on snake-killers after their own deaths. Gratitude, as well as vindictiveness, is ascribed to snakes, of which some characteristic stories are given. In conclusion, Dr. Macgowan observes that the recently established vernacular press in China furnishes inexhaustible stores of folk-lore. "Paragraphs describing popular superstitions, impossible occurrences, monstrosities, and so forth, constitute a great portion of their matter." In regard to snakes, the marvel is that any are killed at all in China, so many dreadful punishments are supposed to overtake their destroyers; and, indeed, it is considered a work meriting favor here and hereafter to purchase captured snakes and liberate them. Nevertheless, poisonous snakes are not numerous in China, probably because their presence is inconvenient to Chinese farmers, and they are therefore destroyed, folk-lore notwithstanding.

— The following practical suggestions, based on results of experiments at the Indiana Agricultural Experiment Station, are offered by Professor W. C. Latta, in the hope that their application would result advantageously on a very large proportion of the wheat farms of Indiana. (1) Sow less wheat; grow more grass, and better live stock. (2) Select a hardy, prolific wheat, adapted to your soil, and stick to it. Give it good treatment and it will not "run out." Sow not less than six pecks of sound seed to the acre. (3) Plough wheat ground early, and harrow immediately after ploughing. You can thus more easily and more thoroughly pulverize the soil. (4) If ground breaks up cloddy, use heavy roll alternating with some form of harrow or cultivator that will bring clods to sur-

face. (5) If manure or fertilizers are used, mix thoroughly with soil in every case. Use only rotted manure, if any, and apply after plowing. Reserve the fresh manure for the corn crop. (6) Before trying a fertilizer, get the experience and advice of farmers whose soils are similar to your own. (7) Test the untried brands carefully, in a small way, before deciding upon their extensive use. This is the best course, for the reason that even the highest grades often act very differently on different soils. (8) Adopt a rotation of crops suited to your soil and needs. It will increase the yield and improve the quality of your crops, enable you to take better care of your live stock, prevent serious insect depredations and fungous diseases, improve your soil and make it more lasting, and put money in your pocket. (9) Bear in mind that soils and climate vary greatly in different localities, and that these potent factors in crop production will very materially affect the results of your work. Therefore, study your local conditions, and intelligently apply the lessons of this bulletin only so far as they may be suited to your needs and surroundings.

— Information has reached us that Mr. Julien of Brussels, the inventor of the Julien electric traction system in operation on the Fourth Avenue street railway in this city, has been awarded a gold medal at the Paris Exposition, for his storage batteries, over competitors from all parts of the world. This is of importance, being confirmatory of the awards obtained by him for his batteries and system of storage battery traction at Antwerp in 1885, by the international congress appointed by the government to report as to the best manner of propulsion of tram cars; and also at Paris in 1886, and at Brussels in 1888, when the Leopold cross was presented him for his invention.

— Russia is organizing a system of technical schools of a very complete form. The schools are of three classes, lower and middle technical schools, and upper, or, as they are so called, trade schools. The first consist of three divisions, for mechanics, chemists, and builders respectively, and the instruction is strictly technical and manual. The second class is intended for assistant engineers and architects, foremen builders, and agricultural bailiffs. The courses of study cover four years, and the students must have completed their primary education before entering the schools. The subjects of study are drawing, mechanics, applied mathematics, and practical exercises bearing on the industry to be followed. These middle schools are divided into five kinds, technical schools of a general character, schools of chemistry, schools of agriculture, schools of architecture, and schools of mines. Some schools combine two or more of these functions, that of Nijni-Novgorod, for instance, two; that of Moscow, three; that of Krasnovodsk also two, agriculture and mining. None of the courses are simply fanciful, all are practical. For instance, in the school of architecture the time will not be spent in sketching Pantheons or designing triumphal arches, but in planning dwellings of a moderate cost, which shall be sound and durable, well warmed and ventilated, well drained, comfortable, and pleasant to live in. The superior trade schools are intended to produce skilled and intelligent workmen in wood and metal. The minister of instruction calculates that the cost of maintenance of a lower school will be about ten thousand dollars per annum, that of a middle school fourteen thousand five hundred dollars, and that of a trade school about six thousand seven hundred dollars.

— An interesting correspondence has been published between the Magdeburgh Fire Insurance Company and Dr. Stephan, head of the German postal and telegraphic service, respecting the relation between the telephone and the electric fluid, from which it appears that, contrary to the general belief, experience in Germany goes to show that a telephone network rather acts as a protection against lightning than otherwise. For instance, in Hamburg, during the period from 1885 to 1888, there was only one case of lightning in the heart of the city, where the net is very dense, but many others in the suburbs where there is no telephone. In Berlin and other German towns, as well as in Copenhagen, similar experiences are reported. Dr. Stephan, however, points out that the imperial telephone network is being laid with every care, and that the number of lightning conductors is very large.

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EDWARD ATKINSON'S PLANS FOR THE WORLD'S FAIR OF 1892.

THE suggestions made by Mr. Edward Atkinson, and printed in *Science*, of Aug. 30, bearing upon the scope of the exhibition to be held in this city in 1892, have attracted much attention from many business men. Voicing the sentiments of those business men and others interested in the success of the exhibition, the president of the Chamber of Commerce of this city requested Mr. Atkinson to present his views more in detail. To this request Mr. Atkinson responded with the following detailed plans for the development of an historic and economic exhibit on certain lines of industry which might be made a part of the proposed exhibition of 1892:—

We may begin with the art of spinning and weaving. The origin of these arts is prehistoric. From the earliest dawn of history woven fabrics have been in use. The linen in which the mummies of Egypt are wrapped is equal in the fineness of the thread and in the texture of the web to many of the examples of the finest work of the modern loom. The distaff is classic, but unless the railway has completed its revolution, some of the natives of northern Italy could be brought to the exhibition who would spin linen thread with the distaff after the manner of Penelope. The loom and the weaver are pictured, as I have been informed, on the walls of Babylon and on the pyramids. The hand-loom worked by the native Egyptians in the same way, and of identical type, could be

brought to the exhibition. Neither the inventor nor the date of the invention of the spinning-wheel is known. The spinning-wheel of the prehistoric type is worked to-day for clothing nine-tenths of the population of China; the wheel and the spinner, the loom and the weaver, could be brought together from there. The wheel and the loom of the same identical type are to-day in operation in the heart of the Southern mountains, working on cotton and wool, and in the western counties of Ireland, working on Irish homespun. The representatives of these prehistoric arts could be brought from there and from many other points in Asia, Africa, South America, Australia, and Polynesia, with examples of all their fabrics, ancient and modern.

Such an exhibition as the one proposed in this paragraph would undoubtedly lead to the establishment of a great and permanent textile museum and weaving school, equal or superior to that at Crefeld in Rhenish Prussia, which was formerly open to Americans, but from which they are now excluded. Such schools have only lately been established even in England, although they have existed for a long time in Germany and France. We have made a small beginning in Philadelphia and in Boston, but nothing in any measure adequate to the necessities of the case. A complete museum of textile fabrics and of looms of various kinds would be among the primary elements required for such a school. The co-operation of the Arkwright Club of Boston, of the Wool and Woollen Association, of the Silk Association, of the Manufacturers' Club of Philadelphia, and of other similar organizations, might be called for in determining the conditions both for the proposed exhibition and for the ultimate destination of the examples of machinery and fabrics which might be brought together at that time.

Within the same rail on the floor of the Atlanta Exposition were two hand carders, two spinners with their wheels, and one weaver, — five persons who could make in a day of ten hours eight yards of narrow coarse cotton osnaburg. Within the same rail was the carding and spinning machinery of the Willimantic Thread Company and the looms which were sent there from Massachusetts, on which the cotton which was growing in the field in the morning, after it had been picked, ginned, and prepared, was spun, woven, dyed, and made into a dress suit which I wore at a reception the same evening. The difference in the capacity of the operatives who worked these modern machines as compared to the homespun art on the same fabric was one hundred to one, by actual computation.

The first step in the progress from the spinning-wheel of a single spindle to the spinning-mule of twelve hundred spindles was the spinning-jenny of eight or ten spindles. Some of these spinning-jennies are still made use of, I believe, in Africa, to prepare the yarn for a hand-loom which is carried about in the hands of the natives, on which they weave the narrow strips of which their garments are made when they have been stitched together. The African spinners and weavers, with their machines, can be brought to the exhibition.

In South America, in Mexico, among the Indians of the far North-west, and in every part of the world, are people of various tribes and races who clothe themselves in homespun and hand-woven fabrics, as our grandfathers and grandmothers did in New England only a century since.

It is easy to conceive of a department in the exhibition of 1892 in which shall be built the cabin of the African, the cobble-stone dwelling of the Irish cottier, the model of the cottage of the English peasant, the dwelling of the Chinaman, the wigwam of the Indian, the log cabin of the Southern mountaineers, where each type of each race may conduct the art of spinning and weaving in their own way; while in the next compartment may be exhibited the finest examples of the most modern textile machinery: in this one section would be given the history of clothing from the fig-leaf to the type of the present day. Even the preparation of the different fibres may be brought into view. The seed of the cotton is cleaned from the fibre in China at the present time by the snapping of a bowstring, precisely as it was done in Georgia, giving the name of "bowed cotton" to the Georgia staple before Eli Whitney invented the cotton gin.

Again, while the art of weaving begins with the hand-loom in making the fabrics of the coarsest kind, the art also ends with the

hand-loom on which the finest silks of Lyons and the finest velvets of Rhenish Prussia are to-day woven; and from these points the typical weavers could be assembled with their simple looms on which they make those finest goods, which are in themselves a work of art.

In the matter of printing textile fabrics, the art began by stamping figures of a coarse and rude kind by hand upon the cloth; and that same art is still carried on in the same way in China and in Japan, and could be brought before the eye in the exhibition; while the progress in the art of printing textile fabrics could be witnessed in the next section as it is now carried on by the use of machines of the finest and highest types. But this art would end again in the bringing from France the block printers, who still print by hand the finest examples of the French cretonnes.

This conception of the method of the proposed exhibition is wholly consistent with making the exhibition itself a medium for bringing into notice the finest examples of modern machinery and the finest types of modern fabrics. The only difficulty which might be experienced in carrying out this conception might be that too many makers of machinery and venders of the fabrics of the finest types would apply for place.

The personal factor and the element of individual profit may therefore be brought to bear in connection with this plan, as well as in any other way. The plan only gives a definite point or purpose to the undertaking, and would make the whole exhibition an example of progress and a means of comparing the mechanism by which the people of different countries and races have clothed themselves or otherwise provided for material wants in the past and do now clothe and serve themselves in the present.

If it were too great an undertaking to bring together typical examples of the garments of the past as well as of the present, nevertheless, pictures may be gathered to hang upon the walls of this exhibition, artistic in their conception, typical of the art in the different countries in their execution, and yet object lessons in the history of the textile arts.

I have in my possession six pictures painted in China on silk, giving the whole story of cotton, from the field to the fabric, which were sent to me by Messrs. Russell and Co. to exhibit at Atlanta, accompanied by a complete set of garments worn by the common people of China. They were sent to me without cost, but were evidently expensive. I have already mentioned the little artistic clay figures which can be purchased in India, showing every type of costume, at a mere trifling cost.

If we pass on from the textile out to the treatment of metal, taking iron as an example, we find that iron is still treated in Spain as it was when the Toledo blade became famous. It is treated in Africa in the crudest manner. In the heart of the southern mountains, iron and steel are still made directly from the ore in wayside furnaces heated with charcoal on what I believe are called "Catalan forges." How various or how widespread over the world are the different methods of treating the ore of iron, I am not informed, but all these primary methods could be brought, with those who practise them, into one section of the exhibition; and since the introduction of the most modern type of furnace worked by gas has been adopted, it has also become possible to set up small examples of the most modern form of producing iron and steel and working these metals into manifold shades. The whole history of metallurgy as applied to iron can be brought before the eye; and here again the element of personal interest may be brought to bear on the part of those who desire to exhibit the most modern types of stoves, smelting furnaces, and the like.

Perhaps the most interesting and the most varied of the many arts which can be brought together into view would be the types of the tools and machines used by various races and nations in the conduct of agriculture. Herein again, the plough, as pictured upon the walls of the Pyramids, could be brought from the fields of Egypt, with the fellahin, who still make use of that prehistoric implement; and alongside could be placed the modern polished steel plough, of which I have a record among my insurance papers that when accidentally placed outside a barn it concentrated the rays of the sun, and reflected them in such a way as to set the barn on fire. Herein, again, there would be a rush of competitors to exhibit the best types of the most modern agricultural tools and machines.

Again, the one art which is of all others prehistoric is that of the potter. Would it not be possible to bring the potters from many lands into a single section with their primitive implements, placed alongside the most modern type of apparatus with their artists as well as their ovens?

Lastly, there is nothing like leather. How easy it would be to bring into the same section the worker in leather from different parts of the world; the cobbler from that part of this country which has not yet been penetrated by the railway, alongside the modern machines by which each visitor, having been measured on entering the section, may have a last prepared to fit his or her foot, and a pair of finished boots made to measure ready to put on, within the time that would be necessary to get even a superficial idea of the mechanism by which the work had been accomplished.

When all these and many other arts had thus been brought together, to be conducted under one great roof by representatives of many races and many nations, each according to his kind dwelling in his accustomed way and conducting all the household arts as they are conducted at home, the Arab in his tent, the African in his hut, the Mexican Indian in his adobe house, the mountaineer of the South in his log cabin, the native of Japan in his dwelling of wood and paper, the Chinaman, the Aleut, the Alaskan, and all the rest — what could be more attractive or instructive? And lastly, what would pay better in a mere commercial sense?

I therefore submit that my conception of an exhibition which shall give the history of industrial progress, by means of object lessons drawn from the past, but yet existing in the present, is wholly consistent with the necessary element of personal interest and personal profit on the part of those who contribute the modern examples of existing machinery.

In addition to these object lessons, the art of the painter, and even of the sculptor, may be invoked to decorate the walls; the art of the engineer and of the mill constructor may be called in to build the structures; while the services of the statistician, the economist and the ready writer, and the engraver would be required to prepare the catalogue and to write the descriptions, so as to tell the whole story of what the eye could see in part.

This would be the main conception to be carried out, either in the main building or in the main series of buildings. Auxiliary buildings may be added by States, in the manner previously indicated, in which examples of every crude material, together with maps and descriptions showing the resources of any section of the country, might be brought together. If, in addition to this, it was thought expedient to make preparation for a great fair or bazaar where goods could be exhibited and sold according to the will of the contributor, that purpose might also be provided for in the exact measure of the demand which would ensue for space or place. The conditions precedent to carry out this conception consist, first, in finding the money which will be required to make the preparation, and, second, the men (especially the man) capable of laying out, executing, guiding, and directing the whole work.

AN UNKNOWN ORGAN OF SENSE.

In the frequent dwelling upon questions of development, which one cannot avoid in these days, one sometimes wonders whether the future is destined to endow man with any senses which he is not now in possession of. However that may be, it is probably unknown to a great many of the laity that within a few years past a new organ of sense has been discovered, the existence of which had not before been so much as suspected. It was always known that the internal ear was a curiously complicated structure, and there was little hope of being able to make out the separate functions, in hearing, played by all its different parts. But it was not suspected, even when Flourens had made his celebrated experiments in 1824, that one part of it — the three narrow semicircular tubes which spread out in three planes at right-angles to each other — might be the organ of a totally different sense. It is only now that the question has been definitely set at rest by the admirable experiments of Brener. There can no longer be any doubt that the semicircular canals are the organ for sensations, whether conscious or not, which enable us to determine both the direction and the amount of all rotations performed either by the

head alone or by the head and body together. The argument by which this has been established is interesting, if only as furnishing another instance of the ins and outs of that great scientific method by which truth is being constantly tracked to its lair.

It was first noticed that the semicircular canals could be destroyed without any injury to the sense of hearing, but that their destruction was followed, in various animals, by convulsive motions of the eyes, the head, and the body, and that these motions were in different directions as different ones of the three canals were destroyed. It was next pointed out that certain diseases in human beings which were accompanied by feelings of dizziness and loss of equilibrium were connected with injury to those organs. Finally, distinct sensations were said to be felt upon the performance of certain motions, not to be confounded with either a muscle-sense or a sense of touch, and not to be explained except by the hypothesis of some peripheral organ. But at this stage of the discussion, physiologists went too fast and too far; many of them held that the semicircular canals are spatial sense-organs upon whose activity depends every perception of the position, or of the direction of motion, of the body. The limitation of their functions to the perception of rotations only has been performed by Delage, and in the following way. He pointed out the aid to be got, in such cases, from the study of illusions.

The mind is able to interpret the data of the several senses in accordance with external fact only when the sense-organ in question is working under normal conditions. Unusual conditions are a frequent cause of illusions, and the source of a given illusory sensation can easily be made out, when it is certain that one organ and only one is subjected to circumstances which it is not accustomed to. Even when this simple situation cannot be arrived at, the same thing can sometimes be accomplished more indirectly. Thus when the head is turned far to either side, the eyes being shut, objects which can be correctly pointed at with the head in a normal attitude seem to have shifted their position about fifteen degrees in the opposite direction. This indicates that the organ which gives us the sense of direction when we are at rest is in the head. But it is in the eye and not in the ear, for the illusion persists when we turn the eyes without the head, and it vanishes when, on moving the head, we force the eyes to remain at rest relatively to it. When we have occasion to look far around, we usually accomplish it by moving the head part of the way and the eyes in the head the rest of the way. We have thus acquired the habit, when we move the head to the right, of moving the eyes still farther to the right, and it is this wrong position of the eyes in the sockets which gives rise to the above illusion. It is the muscles of the eye, therefore, which gives us our static sensations of direction. In a similar way it is shown that our knowledge of the position of the body at any instant is derived, when the eyes are shut, from muscular and cutaneous sensations and from a general sensitiveness to the direction of gravitation of the fluids and internal organs of the body.

The feelings which inform us that we are undergoing a progressive motion in any direction, have a similar general origin, but the case is very different with rotations. In the first place, we have a far more delicate sense of rotation than of progressive motion,—a velocity only one third as great can be detected. The illusions that are produced by turning the head to one side while the body is being rotated about any axis are opposite in direction from those produced by the eye, and much greater in amount; they are, in fact, partly counteracted by the eye-illusions. To produce rotation about a vertical axis, the person is seated in a dark rotating box. He feels himself to be rotating about a vertical axis, as he is, but he has only to turn his head over towards his right shoulder to make himself think that the axis of rotation of the box is inclined towards the left, or that the space about him had been shifted to his right. In other words, he cannot help feeling as he would if his whole body were in a continuous line with his head. A sudden change in the position of the head during a swift rotation is enough to cause dizziness, nausea, and a general feeling of extreme unpleasantness,—so much so that Delage says that it requires a very considerable amount of courage to perform the same operation again. There is no other unoccupied organ in the head which might be taken to be the source of

this illusory sensation, except the semicircular canals, and hence we are under the necessity of attributing it to them.

A few years ago Prof. William James made the interesting discovery that deaf people were in very many instances not subject to dizziness nor to sea-sickness, and that they had, for the most part, given up diving, because they found it impossible to tell one direction from another when under water. A disease of the organ of hearing would be very likely to attack the closely adjacent semicircular canals, and hence these curious observations add great weight to the theory that they are the seat of sensation for certain motions of the body and the head. It may be mentioned that Professor James suggests trying blisters behind the ears, or even a gentle rubbing, as a cure for sea-sickness.

The argument at this point is not absolutely conclusive, though it is exceedingly strong, but it is put beyond any shadow of doubt by the recent experiments of Brener upon doves, already referred to. He cuts down to the bony semicircular canals, and, without having injured them in the least, he succeeds in sending an electric current through them. The head moves in absolute obedience to the current in either one of the three planes according to the canal which is stimulated, and in each plane it moves in one direction or the other, according to the direction of the electric current. With the interrupted current, no motion at all is produced. But how is it certain that it is only the canals that are stimulated, and that the motion is not due to direct stimulation of the brain? This objection, which has long been considered a very weighty one, has been absolutely set at rest by Brener. He inserts the needle, which conveys the current, into the matter of the brain, and motions of the head are, indeed, produced. But he next diminishes the intensity of the current until it is no longer strong enough to produce any effect in that place, and then transfers the needle to the semicircular canals. The motions are immediately set up again. It is, of course, perfectly natural that the effect of the current upon either the brain-centres or the fibres communicating with them should be the same as upon the nerve-ends, but the fortunate circumstance that the nerve-ends are stimulated by a current too weak to affect the adjacent parts of the brain proves conclusively—and by a very pretty piece of logic—that the specific function of those nerve-ends is, in fact, the regulation of the convulsive motions of the head. That they regulate the motions through reflex responses to sensations,—in other words, that the motions are by way of compensation for a subjective feeling of falling in the opposite direction,—is proved by the experience of those individuals who execute the same movements under the influence of disease. The chain of evidence is, therefore, now absolutely complete that the nerves which are distributed upon the enlarged ends of the semicircular canals are sensory nerves whose function (or, at least, one of whose functions) is to give us knowledge of the character and extent of all rotations executed by the head.

Mach, in his "*Bewegungsempfindungen*," published in 1875, described many very ingenious experiments which went to show that we are conscious of a specific sensation when the activity of the semicircular canals is excited. These have not been considered conclusive by other writers, and in a later work of his (*Analyse der Empfindungen*, 1886) he lays less stress upon the excitation of specific sensations, and is content to assume that they set free purely reflectory innervations (p. 73). The semicircular canals may still be called a sense-organ, even though we are not immediately conscious of the sensations which they give rise to. The use of the phrase "unconscious sensation" implies that in the opinion of physiologists there is something which may be properly termed a sensation, but which is not *felt* by us in the ordinary meaning of that word. Any message which is sent in to the brain by an afferent nerve, and which gives rise to actions suitable to the circumstances, is called a sensation, even though our conscious self knows nothing about what is going on until after the action is accomplished, if even then. Thus in the eye-illusion first mentioned, the full explanation of what takes place is this:—the angle through which the head has moved is measured by the semicircular canals, and this information is transmitted to the centres of the eye-muscles, whereupon the eyes make the amount of motion appropriate to that position of the head; their unusual position in their sockets is then telegraphed in by other nerves of sensation, and this infor-

mation has its proper effect upon our intelligent judgments of the position of things about us, and these judgments are the only thing, in the whole process, which we know ourselves to be thinking about.

What is the nature of the mechanical stimulation which excites the nerves of the semicircular canals under ordinary circumstances? Brener produces the motions by making a small incision in the canals, and drawing out the liquid contained in them by a piece of blotting paper. If, when the head is moved, the endolymph remained behind for a short time by inertia, and then rubbed against the hairs of the ampullæ as it moved forward, that might be a means for producing a sensation in the nerve. This retarded movement can actually be seen to take place in artificial glass tubes made of the same shape as the semicircular canals, but of a larger size. But when the tubes are made of the same small size as the actual canals, no effect of inertia can be detected. It is not by any means sure that in the real tubes the retardation would not take place, for they differ in many respects from tubes of glass; an actual retardation, moreover, would very naturally explain the illusion of an after-motion in the opposite direction which is, under some circumstances, very persistent after a rotation has ceased. Mach, however, considers that changes of pressure are quite sufficient to produce the required effect; on calculating their amount he found it to be not so inconsiderable, compared with the energy necessary to affect other organs of sense, as might have been expected. But whether due to changes of pressure, or to rubbing, it is no longer possible to doubt that it is to sensations in the semicircular canals, for the most part unconscious, that we owe that exact knowledge of how far and in what direction we have turned the head at any moment which is necessary to our safe progress every time we attempt to move about in space.

CHRISTINE LADD FRANKLIN.

HARVARD OF TO-DAY.¹

I THANK you with all my heart for this kind reception; but as I look round me and remember how few there are in this large assemblage who have not borne the infliction of my lectures, I am abashed to think how widely my weaknesses and shortcomings must be known. It is fortunate for us old teachers that time so far alters the perspective under which the incidents of college life are seen that our mistakes become less prominent, and our devotion to truth and duty more evident, as we advance in years. Before another generation has passed, I trust that old Father Time will have dealt as graciously with the college work of to-day as he has with our own weak endeavors in the past; but it has seemed to me that many of her friends have of late been criticising Alma Mater very much in the same spirit which her students showed to their teachers in former times, exaggerating her failures and minimizing her successes. In a community of nearly two thousand young men it must be that offences come; and he can have known little of human nature in opening manhood who thinks that by any system of restrictions he can build a wall around the college high enough to keep evil out; and, however much he may dread the conflict, who does not know that no force of character can be attained and no manly virtue won except by meeting the enemy and slaying him?

The discreditable stories which have been so widely circulated about our college have brought upon us the scrutiny of a whole army of reporters; and, whatever of truth or of falsehood there may have been in the sensational paragraphs they have published, of this I am sure, that few societies of men, however sacred their object, could have borne the scrutiny as well. When I have indignantly repelled the scandals, I have been told that I knew nothing about that phase of college life. Thank God I do know nothing about it; and I am in constant association with hundreds on hundreds of young men who know as little about it as I do. We do not expect to solve the problem of evil at Harvard in this generation; but there is this very marked difference between the evil influences of to-day and those of only a few years back. Then the evil was everywhere pervasive. The classes were so small that all the members were brought into more or less intimate association, and

one could not avoid meeting the hateful forms of vice, however greatly he might be repelled by the sight. Now associations are determined to a far greater extent by mutual tastes and affinities; the bad influences are confined to a limited class, and the great majority of our students in passing through college see as little of degrading vice as they would at their homes.

Several years ago an anxious mother consulted me about sending her son to this college. The son was anxious to study in our laboratory, but the mother feared the evil influences of the place. Nevertheless the boy came, as I afterward learned, in consequence of my representations, graduated with highest honors, and is now one of the most promising of the younger members of his profession. The mother followed her son to Cambridge. After she had lived among us for some time, she said to me one day: "I am so much delighted with this place. Things are so different from what I expected. I was told such horrid stories, and not one word of them is true." We have at least one sincere advocate, who has been convinced by experience; and there are numbers of young men who graduate from Harvard every year as guileless as this earnest woman's son.

My friends, I can assure you that the great danger of our dear college at the present time is not over dissipation, but over work. Sixty thousand dollars cannot be distributed in prizes every year without producing an enormous strain; and those of us who are directing the workers know how intense the activity is. We may know little of the evil around us, but we do know a great deal of the good. We know of lofty purposes and of earnest endeavor. We know of perseverance under great discouragements, and of victories won against heavy odds. We know of self-control and of self-devotion. We know of Christian duties habitually practised, and of truth and right manfully upheld; and we maintain that the character of a community of scholars is to be judged by such traits as these, and not by the occasional lapses of its weaker members.

Moreover, I am not one of those who think that a man is necessarily condemned because he is born with a gold spoon in his mouth, or that educated leisure is an unmitigated evil. The college has done a good work in educating rich men, and it owes a great part of its present influence to the noble use which many of its alumni have made of inherited wealth. Such men are educated more by association than by direct instruction; and, as a former president of the college once said, they gain something if they merely rub their backs against the college walls; and if this was true in the past, how much more is it true in the present, when the intellectual life of the college is so much more active, the standard of scholarship so much higher, and the opportunities of cultivating special tastes so greatly enlarged. You cannot expect of such men the asceticism of an anchorite, or the plodding diligence of a scholar; but the university owes them an education, and the duties and obligations are not wholly on one side.

During the last twenty-five years the life at the university has been rendered safer and more healthy, in every respect, by a greatly increased enthusiasm for learning, which extends to almost every department of this large institution. In no one respect has the improvement in the college been more striking than in this; and probably no officer of the college has had better opportunities of observing the change than myself. For forty years I have lectured to the successive freshman classes, beginning with the class which entered in 1849; and many of the older men around me will remember the boyish pranks which in their college days not infrequently amused the class, and greatly tried the temper of the teacher. The lecture was always an up-hill work,—a duty to be enforced on the one side, a task to be endured on the other. The lecturer was always waiting on disturbance, the class always waiting on deliverance. Not only was there no general enthusiasm, but the first suspicion of such a thing in a college lecture-room would have been regarded as a dangerous precedent, alike compromising the dignity of the teacher and violating the traditions of the place. Now, although the classes have so outgrown the accommodations that not only all the seats, but all the approaches to my lecture-room, are crowded almost to suffocation, a more orderly, a more attentive, or a more enthusiastic audience cannot be found. This change is due not simply to our elective system, but far more

¹ Address by Josiah Parsons Cooke, LL.D. at the commencement dinner at Harvard University, on June 26, 1889.

to the putting away of those petty restrictions which were formerly a constant menace, and erected an impassable barrier between the teacher and the taught. We no longer, like the Irishman, stand aloof with a chip on the shoulder, and dare any of the boys to knock it off; but we invite confidence, and receive it, and our relations with the students is not that of taskmaster and toiler, but that of guide and friend. Had our worthy president done no more than break down that old middle wall of partition, he would for this great feature of his administration alone deserve the everlasting gratitude of this community. And let me entreat you, my brethren, not to allow any one to reinstate this wall, or even to lay the first brick in its reconstruction.

Most of our sister institutions are struggling with hobbledehoydom still. Only a few days ago, one of our distinguished graduates, and a highly valued professor in another New England college, said to me: "Cambridge men do not appreciate the advantages they have gained by setting their students free from petty restraints. Treat men as boys and they will act as boys. With us the boyishness first breaks out in the chapel, and then extends to all the classrooms. It belittles all our work, and dampens all our enthusiasm." My friends, in an institution of learning like this, you cannot prize too highly the ennobling virtue of enthusiasm. To awaken it is to make the boy a man. To fail to arouse it, at least in something, is to miss the great end of education. But such virtue cannot be had without cost. Enthusiasm implies of necessity freedom; and who in this New England, after a century's experience, is not willing to incur the risk and pay the cost which freedom entails?

Finally, brethren, while noble character is the crowning grace of education, scholarship is the brightest jewel in this crown; and you may well ask, Has learning kept pace with privilege? But in attempting to answer this question I find myself in the dilemma of the learned commentator who had devoted a chapter to the snakes of Iceland. He could find no snakes, and I can find no comparison. The scholarship of to-day rests on a level so much higher than that of twenty-five years ago, that there is no common measure. I will confine myself to my own department, of which I have accurate knowledge, and of which I may speak unreservedly, because it has so broadened out that only a small part of the instruction now devolves on the director. Besides the very large class, before referred to, which attended the elementary lectures, there were actually working in the chemical laboratory last year more students than were comprised in the whole college of my day, and the contributions to chemical science which will soon be published, as the result of the year's work of students as well as of teachers, will fill more than one half of the annual volume of our American academy. A recent writer in the *Atlantic Monthly*, discussing "Why our Students go to Europe," pays us what he evidently regards as a high compliment in saying, "Now the chemical course at Harvard equals that in most German universities." Our own students who have gone from the laboratory to study abroad will tell you, as they have told me repeatedly, that, whatever advantages may be gained by association with men of special attainments, there is no University in Germany, or elsewhere, at which the instruction is at once so broad, so full, and so thorough as at home. How does this compare with recitations from "Stöckhardt's Chemistry," illustrated by popular lectures?

Fellow alumni, our attention has been so often and so loudly called of late to the shady side of college life, that, whatever opinions you may have formed, I am sure you will not blame me for inviting you on Commencement day to bask for a few minutes in its sunshine. At such a time we can only meet assertion with assertion; but I have spoken solely of what I do know, and if any one is not convinced I invite him, following the example of the anxious mother, to come and dwell among us and partake of our life. Obviously I am no pessimist, but also I am no optimist. The members of this great family are all frail human souls. Evil is ever present with us, as it was with our fathers and will be with our children. We cannot escape the curse. But we have faith in truth and right, and will fight the good fight to the end.

"O yet we trust that somehow good
Will be the final goal of ill,
To pangs of nature, sins of will,
Defects of doubt, and taints of blood."

We all boast the same intellectual parentage. You for the most part have gone out into the world and found a career elsewhere. I am one of the few who have always stayed by the homestead since I was first received into the brotherhood with the Class of 1848. For nearly half a century I have known the dear old Mother as well as a devoted son possibly could; and let me assure my brothers who have come home to keep this feast, that during her long life our Alma Mater was never so worthy of our admiration and veneration, of our love and devotion, as she is this day.

BOOK-REVIEWS.

A Manual of Machine Construction, for Engineers, Draughtsmen, and Mechanics. By JOHN RICHARDS. Philadelphia, Lippincott. \$5.

AN experience in constructive engineering extending over a period of thirty-five years, in both Europe and America, has admirably qualified Mr. Richards for the task of preparing this volume. That the task is well done, will not be doubted by those acquainted with his previous work in the same line, which includes a number of treatises on various mechanical subjects.

The book is unique in more than one respect. It is intended to meet the every-day wants of the practical man, in draughting-room or work-shop, and is consequently more a work of direct application than of theoretical instruction. While concise, as such a book must necessarily be, it nevertheless touches with sufficient detail on many minute points concerning which very little has heretofore been accessible in print. The author states that the preparation of the work was suggested many years ago by the inconvenience of common references such as are required in usual machine practice, and by a belief that some more simple form, adapted directly to use, and confined to those things most commonly dealt with, would be of value. Being made up mainly from the personal experience of the author, reproducing and classifying work already constructed, the book presents in a convenient form material gathered in the course of a long and diversified experience, the exact rules formulated in accordance with theoretical considerations being modified to suit the limitations and exigencies of actual practice.

A peculiar feature of the book is its make-up, being bound so that it opens at the end of the page instead of at the side, after the manner of a reporter's note-book, or legal-cap paper; and each alternate page is left blank, for convenience in reference and also to receive notes and original matter. The page titles and numbers are placed at the bottom of the page to facilitate convenience in reference.

The volume is divided into sections on machine design, the transmission of power, steam machinery, hydraulics, and processes and properties, followed by a section devoted to tables and memoranda of weights and measures; standards for screws, bolts, and nuts; sizes of wood and machine screws; circumferences and areas of circles; square and cube roots, etc. To engineers and draughtsmen engaged in machine design or construction, this book will prove of special value.

Monopolies and the People. By CHARLES WHITING BAKER. New York. Putnam. 12°. \$1.25.

THIS work is an attempt to solve the problems presented by the new form and organization of industry. The author is impressed, as most persons are, by the rapid growth of "trusts" and other combinations of a monopolistic character, and by the evils they sometimes produce; and he here undertakes to furnish a remedy for those evils. He writes in a judicial tone and with an evident desire to be fair to all parties. He gives an account of the origin and growth of the combinations known as "trusts," with other chapters on monopolies in minerals and transportation, placing also the labor unions in the general class of monopolies. He regards them all as natural outgrowths of existing industrial conditions, and while he acknowledges that they are in some respects beneficial, he is especially impressed with the abuses that attend them. So far his readers will probably agree with him; but when he comes to state the remedies for the evils he speaks of, we, at least, are obliged to dissent. He holds that the true remedy for monopoly is

not abolition but control, and the control he advocates involves what we should call a violent interference by the state with all the operations of industry. For instance, he proposes that the United States shall buy up all the railroads in the country, paying for them with three per cent bonds, and then lease them to private companies. All fares and freight tariffs are to be fixed by government commissioners, and the government is also to have a share in the directorship of the companies. Mining and gas companies are to be treated in a similar way, but on the subject of manufacturing monopolies Mr. Baker speaks with more hesitation, the principal measure he proposes being a requirement that all such associations as the "trusts" shall sell to all persons at the same price. Such are his remedies for the evils of monopoly; but to our mind they involve altogether too great an interference with the natural course of industry, and we believe the American people will agree with us in this opinion. New laws will doubtless be needed to remedy the abuses that Mr. Baker has here set forth; but such a widespread interference with industry as he advocates would, we feel sure, result disastrously.

AMONG THE PUBLISHERS.

BERGER'S "French Conversations, Idiomatic Expressions, and Proverbs" (New York, F. Berger) has reached a fifth edition.

—Macmillan & Co. will publish early in the fall a revised edition of Mr. Alfred Austin's poem, "The Human Tragedy," which will contain likewise a prefatory essay on "The Present Position and Prospects of Poetry."

—J. Maisonnave, publisher and bookseller, of 25 Quai Voltaire, Paris, has issued a catalogue of rare and valuable works relating to America, in which attention is specially called to the "Letter of Christopher Columbus announcing the discovery of the New World," in the original Spanish text, first edition.

—Cassell & Company have just ready Max O'Rell's new book, "Jacques Bonhomme," a lively description of French manners and customs, to which is added "John Bull on the Continent" and "From my Letter-Box."

—Lee & Shepard have ready "Observation Lessons in the Primary Schools," by Louisa P. Hopkins, a manual for teachers, presenting practical methods for teaching elementary science to the young.

—A. C. McClurg & Co., Chicago, will publish shortly, "Fact, Fancy, and Fable," by H. F. Reddall, a work of comprehensive and cyclopedic character, presenting concise information on a great variety of subjects.

—The publishers of *St. Nicholas* announce that that popular children's magazine is to be enlarged, beginning with the new volume, which opens with November, 1889, and that a new and clearer type will be adopted.

—During the coming volume *The Century* is to have an illustrated series of articles on the French salons of the seventeenth and eighteenth centuries, including pen portraits of many of the leaders and a detailed account of the organization and composition of several historical salons. A great number of interesting portraits will be given with the series.

—Houghton, Mifflin & Co. have published in the series of American Statesmen "Benjamin Franklin," by John T. Morse, Jun., the editor of the series and author of the volumes on John Adams, Thomas Jefferson, and John Quincy Adams; "Recollections of Mississippi," by Hon. Reuben Davis, a graphic description of life in the South for the half century before the civil war; "Literary Landmarks," a guide to good reading for young people, by Mary E. Burt, Teacher of Literature in the Cook County Normal School at Englewood, Ill., with charts; and Part iv. of the Child's "English and Scottish Popular Ballads."

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Physical Realism: being an Analytical Philosophy from the Physical Objects of Science to the Physical Data of Sense. By THOMAS CASE, M.A., Fellow and Senior Tutor C.C.C. Oxford. 8vo, \$5.00.

"Mr. Case has here placed before the public a theory which is in many respects strikingly new, and in all conscientiously worked out. . . . We desire to say that this book is one that ought to be read, and the theory, as here presented, must be considered by all serious students of these matters."—*Saturday Review*.

Force and Energy: a Theory of Dynamics. By GRANT ALLEN. 8vo, \$2.25.

"Written with extreme lucidity. . . . We can safely assure our readers that, whatever view they may take, they will find Mr. Allen's book pleasant and profitable reading."—*Engineer*.

A Text-Book of Elementary Biology. By R. J. HARVEY GIBSON, M.A., F.R.S.E., Lecturer on Botany in University College, Liverpool. Crown 8vo, \$1.75.

"As a text-book of elementary biology it is one of the best that has ever been published. The typography and general execution of the book leave nothing to be desired."—*Science*.

The Fundamental Principles of Chemistry Practically Taught by a New Method. By ROBERT GALLOWAY, M.R.I.A., F.C.S., Hon. Member of the Chemical Society of Lehigh University, etc. With 71 Woodcuts and 729 Exercises and Answers. Crown 8vo, \$1.75.

A Hand-Book of Cryptogamic Botany. By ALFRED W. BENNETT, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas's Hospital; and GEORGE MURRAY, F.L.S., Senior Assistant Department of Botany, British Museum. With 378 Illustrations. 8vo, \$5.00.

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Astronomy for Amateurs: a Practical Manual of Telescopic Research adapted to Moderate Instruments. Edited by J. A. WESTWOOD OLIVER, with the assistance of Messrs. MAUNDER, GRUBB, GORE, DENNING, FRANKS, ELGER, BURNHAM, CAPRON, BACKHOUSE, and others. With Illustrations. 12mo, \$2.25. "The book supplies a real need."—*Sidereal Messenger*.

Modern Theories of Chemistry. By Prof. LOTHAR MEYER. Translated from the fifth edition of the German by P. PHILLIPS BEDSON, D.Sc., Lond., B.Sc., Vict., F.C.S., Professor of Chemistry, Durham College of Science, Newcastle-on-Tyne, and W. CARLETON WILLIAMS, B.Sc., Vict., F.C.S., Professor of Chemistry, Firth College, Sheffield. 8vo, \$5.50.

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The Diseases of Children. Medical and Surgical. By HENRY ASHBY, M.D., Lond., M.R.C.P., Physician to the General Hospital for Sick Children, Manchester; and G. A. WRIGHT, B.A., M.B., Oxon., F.R.C.S., Eng., Assistant Surgeon to the Manchester Royal Infirmary, and Surgeon to the Children's Hospital. With 138 Illustrations. 8vo, pp. xx-681. Cloth, \$6.00.

Lectures on Pathological Anatomy. By SAMUEL WILKS, M.D., F.R.S., Consulting Physician to Guy's Hospital, and the late WALTER MOXON, M.D., F.R.C.P., Lecturer on Pathology at Guy's Hospital. Third edition, thoroughly revised. By SAMUEL WILKS, M.D., LL.D., F.R.S. 8vo, \$6.00.

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NEW MEDICAL AND SCIENCE CATALOGUES SENT UPON APPLICATION.

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— Harper & Brothers have just ready "A History of the Kansas Crusade: its Friends and its Foes," by Eli Thayer, who planned and organized the movement by which Kansas was made a free State, with an introduction by Edward Everett Hale, a fellow-worker with Mr. Thayer in the emigration cause; and "Man and His Maladies," a popular handbook of physiology and domestic medicine, by A. E. Bridger.

LETTERS TO THE EDITOR.

**Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.
The editor will be glad to publish any queries consonant with the character of the journal.
Twenty copies of the number containing his communication will be furnished free to any correspondent on request.*

The Law of Population in the United States.

PURSUING the investigation of the law of population, we come to a question of importance in an economical and ethnographic view. What is to be the relative progress in numbers of the Caucasian and the African races here?

The late revolution in Hayti has led to the publication in the daily press of America of so many concise abstracts from the history of that African republic as to make it familiar to all who interest themselves in these matters. It is to be regretted that the progress of regulated liberty in that island has not, in a century, been greater. It is a prevailing belief that with us the African increases faster than the Caucasian. The figures of the census during a hundred years do not confirm this opinion. We find that while the whites since 1790 have increased on the average in each decade by 33.46 per cent, the blacks have gained in the same time only 26.81 per cent.

Applying these rates to the present numbers we may forecast the *possible*, if not the probable, population, during the next century as follows:—

Year.	Total population.	African descent.	Proportions.
1890.....	67,240,000.....	8,000,000.....	8 to 1
1900.....	89,738,000.....	10,144,000.....	
1910.....	119,650,000.....	12,862,000.....	
1920.....	159,890,000.....	16,309,000.....	10 " 1
1930.....	213,320,000.....	20,681,000.....	
1940.....	284,697,000.....	26,223,000.....	11 " 1
1950.....	379,960,000.....	33,252,000.....	
1960.....	507,090,000.....	42,163,000.....	12 " 1
1970.....	676,760,000.....	53,463,000.....	
1980.....	903,200,000.....	67,790,000.....	
1990.....	1206,400,000.....	85,957,000.....	14 " 1

The reader can draw his own inferences from these significant figures. We only say that in 1940 and thereafter this country will not be able to offer free space and citizenship and suffrage for the surplus overflowing of China, to a race which does not assimilate with us, and which is pagan; and that it is time to discontinue the complaint that the Chinese exclusion act was mere demagogism. In the light of these figures, it was the highest statesmanship. The importation of native Africans ceased by the Constitution in 1808, though it is alleged that a few fanatics imported cargoes later. But practically the forced importation ceased then. There never has been any voluntary immigration from Africa.

Both Malthus, in 1794, and Alison, in 1840, held that the population of the United States after 1640 doubled every twenty-three and a half years. This rate has continued to 1890, for two hundred and fifty years.

M. C. MEIGS.

Washington, D.C., Sept. 2.

INDUSTRIAL NOTES.

Comparison of different Street Car Systems.

BEING continually requested by street railroad men to furnish them with a statement of the cost of equipment and operation of a road by means of storage battery traction, and also how the cost of this method of traction will compare with other systems, the Julien Electric Traction Company of this city have made a comparison of the four methods available to-day for street-car propulsion in large cities,— horses, storage batteries, electric conduit, and cable. The estimates and comparisons, it is claimed, have been carefully prepared, and special attention has been given to obtain good authority for statements, mostly from roads having the different systems in actual operation. The estimates are based on a medium-sized road running on the headway generally employed in cities, trying, as far as possible, to cover roads operating under such different circumstances as are found in different localities.

The company mainly aim to treat the subject as applied to cities. They have not included figures on the overhead system as they consider them barred from operating in that field, owing to the necessity of the presence of overhead electric conductors, and the growing sentiment in all communities against the erection of poles. As regards the Julien system, the figures show the results of two years' experience on the Fourth and Madison Avenue line in this city.

The estimates are based on a road six miles long, double track, operating sixty cars, running eight miles an hour by mechanical, and six miles an hour by animal traction, running on one and one-half minutes headway, and eighty-four miles a day in the former, and on two minutes headway, sixty miles a day, in the latter case, allowing nine horses to a car. The item of building and land is not included, as they differ so widely in different cities and localities.

According to the figures given, the cost of constructing and equipping such a road, on the Julien storage battery system, would be \$491,500, or, if the current were taken from a central lighting station, \$419,000; the same road constructed and equipped for a horse railroad, \$229,620; as a cable road, \$1,076,000; as a conduit electric road, \$762,000. The annual running expenses under the different systems would be as follows. Julien system, eighty-four miles a day per car, with electric plant, \$99,206, being \$4.52 per car-day, or .053 of a cent per car-mile; same system, using current from a lighting station, \$113,330, being \$5.17 per car-day, or .061

of a cent per car-mile; horse traction, sixty miles a day per car, \$129,562.20, being \$5.91 per car-day, or .098 of a cent per car-mile; cable road, eighty-four miles a day per car, \$163,712.50, being \$7.47 per car-day, or .089 of a cent per car-mile; electric conduit system, eighty-four miles a day per car, \$111,157.50, being \$5.07 per car-day, or .06 of a cent per car-mile.

Carhart-Clark Standard Cells.

In last week's *Science* appeared an abstract of a paper on an improved form of Clark standard cell read before the American Association for the Advancement of Science by Professor H. S. Carhart of the University of Michigan, vice-president of the Physical Section of the association. We add a few points relating to the special features of this cell and its mounting for commercial and scientific purposes, as sold by James W. Queen & Co., Philadelphia, who have the exclusive handling and sale of it.

This cell embodies several new and important features, chief among which are its low temperature coefficient and safety in transportation. These features are secured by the methods of Professor Carhart, devised after a series of investigations extending over nearly three years. The change of electromotive force produced by a temperature change of a few degrees is practically negligible except in scientific work of the greatest accuracy. The coefficient is only 0.038 per cent per degree C. This is somewhat less than one-half the coefficient of Lord Rayleigh's form, for which he found a value ranging from 0.077 per cent to 0.082 per cent per degree. Almost absolute safety in transportation is secured by confining the mercury to the bottom of the cell, thus precluding the possibility of its reaching the zinc and short-circuiting the cell, no matter how violently it may be shaken. This process presents the additional advantage of increasing the electromotive force about 0.35 per cent above the old form, and of preventing local action, by which very serious changes took place in the old form of the cell on open circuit. Greater uniformity and constancy, it is believed, result from this method of making a cell.

Another well-marked characteristic of these new cells is their remarkable uniformity. This is due to great care in the preparation of the salts and standard solutions, and to the absolute cleanliness observed in every part of the cell. In the Clark cell, as made by Lord Rayleigh, the mercury salt always turned from its normal white to a canary yellow on mixing with the zinc sulphate, a change probably due to the presence of mercuric salt. In this

new form the salts remain white if they are kept out of the light, no change whatever in color appearing on mixing the mercurous sulphate with the zinc sulphate. This result is secured by the greatest care in making the mercury salt. It is found that a mercurous sulphate can be made so free from the mercuric form that it does not turn yellow when all the acid is washed out.

Professor Carhart says, in a letter to Queen & Co. of July 8, 1889, "Sent you six new standard Clark cells, numbers 106, 107, 108, 109, 110, 111. The extreme difference between these cells when only four days old was only 0.0006 of the electromotive force of the cell, and they were still approaching one another. There was a difference of only 0.0003 between five of these, and only 0.0001 between four of them." Again, referring to six cells, not made in the latest secure form for transportation, which were sent by express from Ann Arbor, Mich., to Queen & Co.'s laboratory in Philadelphia, and returned to Ann Arbor, a journey of over fourteen hundred miles, he writes, "After letting the cells rest thirty-six hours I am much gratified to find that their extreme difference from one another is only 0.08 per cent, and the average of the six cells is only 0.08 per cent lower than my standards kept here." These are remarkable results from such a severe test as this, but the latest form will make a still better record.

A new process of sealing the cell is also employed. Marine glue, which was recommended by Lord Rayleigh as a sealing material, always gave trouble to secure a firm hold on glass and to prevent air bubbles from being inclosed to such an extent as to greatly weaken the seal. Its viscosity was also such that any small internal pressure, due to heat or the generation of a little gas, was liable to force the cell open. With the new compound employed the closure remains perfectly firm, and forms an entirely satisfactory hermetic sealing.

These cells are all set up by Professor Carhart in the physical laboratory of the University of Michigan, and are furnished with his personal certificate, giving the electromotive force of the cell, its temperature coefficient, and guaranteeing each cell "provided no current greater than 0.00002 ampère be passed through it, and provided it be subjected to no violent mechanical strain or jar." With even a larger current than the above, these cells show no polarization whatever in five minutes, and with ten thousand ohms external resistance a polarization of only 0.01 per cent is observed in this time. The cell recovers from this small polarization, which is less than the usual accidental differences between different cells, in five minutes or less. The errors arising from ignorance of the exact temperature of the cell are greater than any liable to occur from polarization. To guard against accidental short-circuiting, Queen & Co. are mounting a graphite resistance of about twenty thousand ohms in circuit with the cell and inside the case which incloses it. These cells are mounted in handsomely finished brass cases, $3\frac{3}{4}$ inches high and $2\frac{3}{4}$ inches in diameter, with an engraved hard rubber top, giving the number of the cell corresponding with the certificate, indicating the positive and negative poles, and having a hole for the insertion of a thermometer to ascertain the temperature in the inside of the cell. Batteries of these cells, in any number desired can be mounted if required.

Boissier Dynamos for Plating and Lighting.

THE dynamos shown in the accompanying illustrations possess some features of novelty, invented and patented by Mr. Herman Boissier, electrician of the Arnoux & Hochhausen Electric Company of this city. The aim of the inventor was to produce a dynamo of low first cost, not liable to get out of order, and so simple in construction that it would require no more attention than could be given it by any workman of average intelligence in plating or electrotyping establishments. The favor with which the machines have been received and the flattering testimonials of those who use them would seem to indicate that the dynamos approximate very closely to the inventor's ideal.

The machine shown in Fig. 1 occupies a floor space of only sixteen by twenty-six inches, and weighs about a hundred and thirty-five pounds, of which only about thirty-five pounds are copper. It furnishes current for twenty-five sixteen-candle-power lamps, or a proportionate current of lower voltage when wound for plating purposes. Owing to the peculiar method of winding the armature,

there are only four sections to the commutator. Fig. 2 shows a form of dynamo made specially for use in electrotyping establishments, and furnishing a current of very low voltage. The field

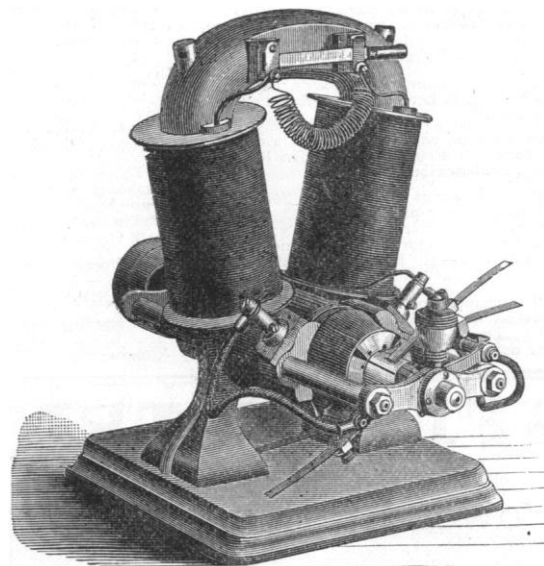


FIG. 1.—BOISSIER DYNAMO.

coils are composed of copper ribbons alternating with ribbons of insulating material. The armature, shown in Fig. 3, is composed of heavy copper bars passing round a cylinder of insulated soft

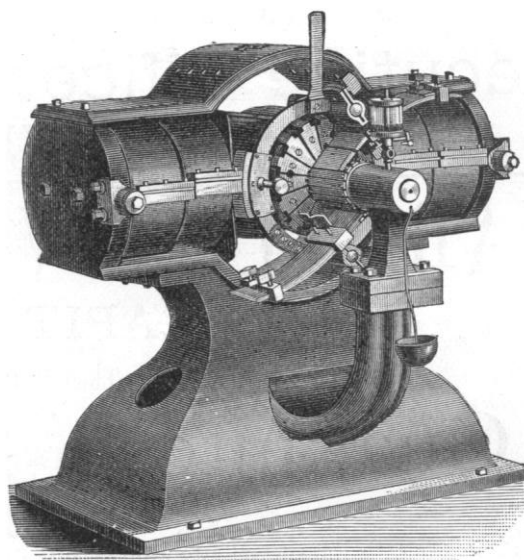


FIG. 2.—BOISSIER DYNAMO.

iron wire. All insulating material on the armature is fire-proof, so that it is impossible that the armature should ever burn out. Two of these dynamos are in use in the government printing office at

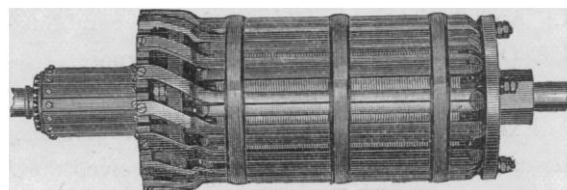


FIG. 3.—ARMATURE OF PLATING DYNAMO.

Washington, in the electrotyping department, where they have a record of three hundred ounces of copper deposited in two hours, using one machine only. They are manufactured by the Arnoux & Hochhausen Electric Company.

Exchanges.

[Exchanges are inserted for subscribers free of charge. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

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I want to correspond and exchange with a collector of beetles in Texas or Florida.—Wm. D. Richardson, P.O. Box 223, Fredericksburg, Virginia.

100 botanical specimens and analyses for exchange. Send list of those desired and those which can be furnished, and receive a similar list in return. Also cabinet specimens and curiosities for the same. Scientific correspondence solicited.—E. E. Bogue, Orwell, Ashta County, O.

I will sell to chapters or individual members of the Agassiz Association, 25 fine specimens of fossil plants from the Dakota group (cretaceous), correctly named, for \$2.50. Send post-office order to Charles H. Sternberg

(author "Young Fossil-Hunters"), 1033 Kentucky Street, Lawrence, Kan.

One mounted single achromatic photographic lens for making 4×5 pictures, in excellent condition; also one "new model" double dry-plate holder (4×5), for fine geological or mineralogical specimens, properly classified.—Charles E. Frick, 1019 West Lehigh Avenue, Philadelphia, Penn.

Drawings from nature—animals, birds, insects, and plants—to exchange for insects for cabinet; or I will send them in sets of ten each for ten cents in stamps. My drawings in botany are in detail, showing plant, leaves, flowers, seed, stamens, pistils, etc.—Alda M. Sharp, Gladbrook, Io.

The undersigned wishes to make arrangements for the exchange of *Lepidoptera* of eastern Pennsylvania for those from other localities. All my specimens are named and in good condition.—Charles S. Westcott, 613 North 17th Street, Philadelphia, Penn.

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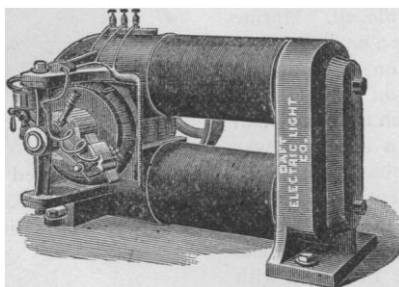
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